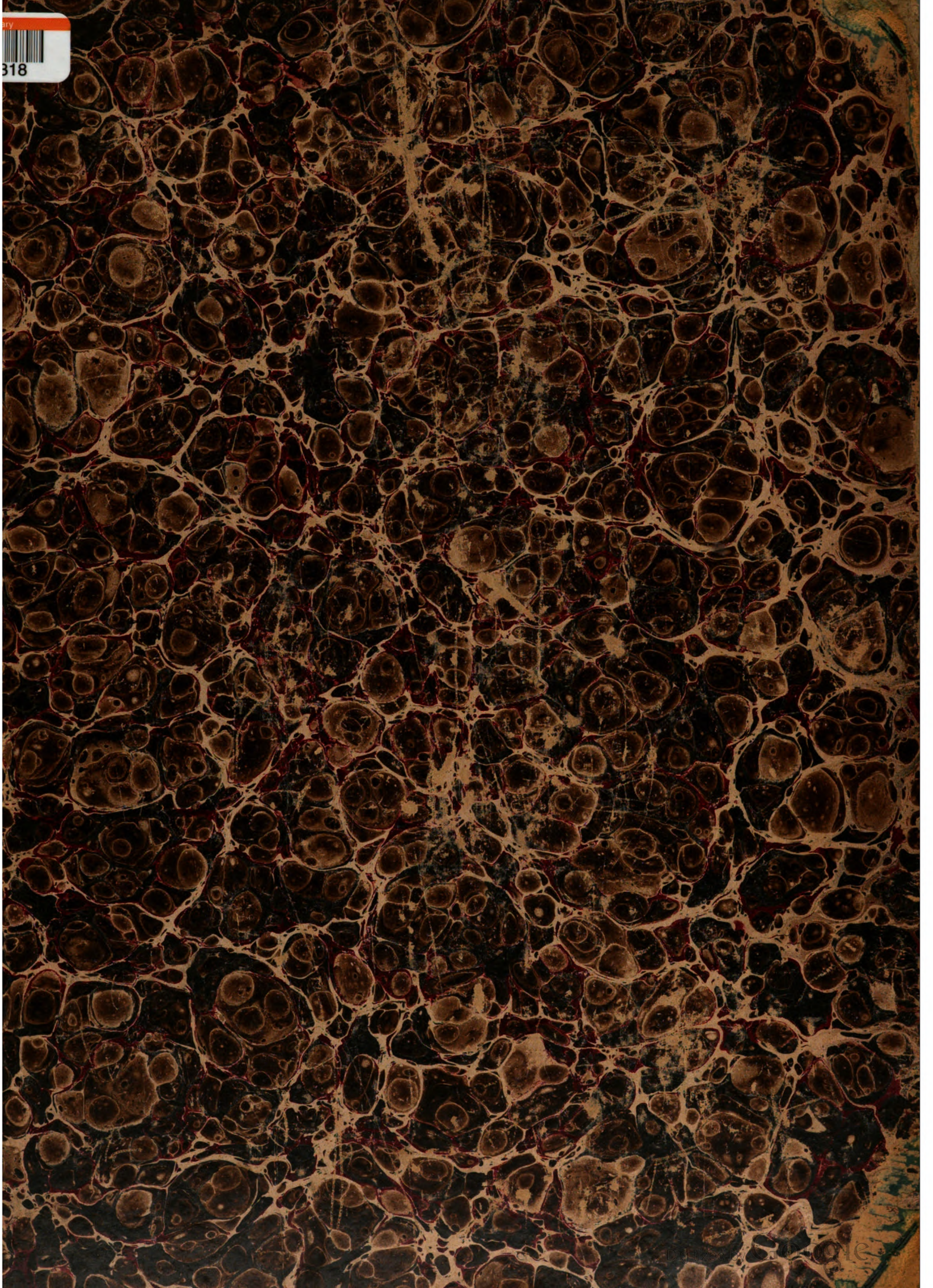

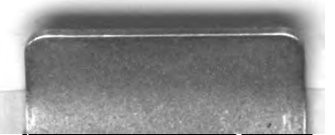

JOURNAL

OF THE

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VOLUME VIII.

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JOURNAL OF THE TELEGRAPH.

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OCEAN TELEGRAPHY.

BY GEORGE B. PRESCOTT.

(*From the Scientific American.*)

NUMBER I.

If the unexpected discoveries and gigantic works which have been realized during the past half century had not familiarized us with the marvelous, we should consider the accomplishment of ocean telegraphy to be the eighth wonder of the world: a wonder, on account of the almost supernatural results which it furnishes, the numerous difficulties which it has encountered, the physical results which it has produced: and even a wonder on account of the enormous amount of money which has been expended in its development. In discussing the extent of this marvelous system of international communications, it seems proper to consider to whom is due the credit of taking the first steps toward its accomplishment. Up to 1847, no substance suitable for the insulation of a submarine wire was known. During that year, Mr. John J. Craven obtained and experimented with some gutta percha, and discovered its insulating qualities and its adaptibility to subaqueous communication. The Trenton, N. J., *State Gazette*, for May 10, 1848, contains the following paragraph: "Gutta percha is now used for insulating telegraphic wires. Mr. Craven has tried it for the old New York and Philadelphia line in the Passaic river, and has been so successful that the company intend to try to cross from Jersey city to New York by laying several wires, thus insulated, under the water." The New York *Tribune* of June 17, 1848, contains the following paragraph: "The wires of the New York and Philadelphia Telegraph have been extended across the Hudson from Jersey City, and are now in successful communication with that place. They are encased in a double covering of gutta percha, and laid on the bottom of the river in the track of the ferry boats."

In 1846, Mr. James Reynolds, of New York, invented a machine for covering wire with india rubber, and during the year 1847 covered a large amount of wire with this substance; but in consequence of the difficulty of drying it (vulcanization of rubber being then unknown), it proved a failure. Early in the Spring of 1848, Mr. Craven brought a piece of wire covered with gutta percha to Mr. Reynolds, and asked if he could cover wire with gutta percha with his machine. Mr. Reynolds undertook to do so, and immediately proceeded to manufacture gutta percha covered wire. He covered the cable which was laid across the Hudson river between New York and Jersey City, *which was the first gutta percha cable ever made, and the first submarine wire ever constructed and successfully operated for the transmission of intelligence over a distance of half a mile.*

One of Mr. Reynolds' workmen, named Champlin, shortly after this cable was laid, went to England and communicated the process to the Gutta Percha Company, who at once commenced the manufacture of gutta percha covered wire.

On the 16th of December, 1859, Mr. Charles Vincent Walker, an experienced telegraph engineer, testified before the joint committee, appointed by the British Government to inquire into the construction

Figure 1.

of submarine telegraph cables, as follows: "I was the first to use gutta percha in England. I advised Mr. Foster, of Streatham, to apply it in our very early difficulties in telegraphing. We purchased and used the first wire covered with gutta percha, on November 11, 1848."

The first submarine cable ever laid in the open sea was laid between Dover and Calais, in 1850. It was

Figure 2.

a single strand of gutta percha, unprotected by any outside coating, and worked only one day. The next cable was also laid between Dover and Calais, in 1851. This cable contained four conducting wires, was 27 miles in length, and weighed 6 tuns per mile. This cable is still working, after having been down 23 years. The next long cable was laid in 1853, between Dover and Ostend, a distance of 80 miles, and contained six conducting wires, and weighed 5½ tuns per mile. It is still in working order. In 1853 a cable of one conducting wire was laid between England and Holland, 120 miles, weighing 1½ tuns per mile. This cable worked for twelve years. From 1853 to 1858, 37 cables were laid down, having a total length of 3,700 miles; of which 16 are still working, 13 worked for periods varying from a week to five years, and the remaining 8 were total failures.

On the 6th of August, 1858, the first Atlantic cable was laid between Ireland and Newfoundland. The weight of this cable was 1 tun per mile, and its cost was as follows: Price of deep sea wire per mile, $200; price of spun yarn and iron wire per mile, $265; price of outside tar per mile, $20. Total per mile, $485. Price, as above, for 2,500 miles, $1,212,500; price of 25 miles shore end at $1,450 per mile, $36,250. Total cost, $1,249,235. This cable worked from August 10 to September 1, during which time 129 messages were sent from Valentia to Newfoundland, and 271 from Newfoundland to Valentia. The failure of the cable was mainly due to carelessness in the manufacture and subsequent handling. When the cable was in process of manufacture, it was coiled in four large vats, and left exposed day after day to the heat of a Summer sun. As might have been foreseen, the gutta percha was melted, and the conductor which it was desired to insulate was so twisted by the coils that it was left quite bare in numberless places, thus weakening and eventually, when the cable was submerged, destroying the insulation. The injury was partially discovered before the cable was taken out of the factory, and a length of about thirty miles was cut out and condemned. This, however, did not wholly remedy the difficulty, for the defective insulation became frequently and painfully apparent while the cable was being submerged. Still further evidence of its condition was offered when it came to be cut up for charms and trinkets.

The next long cable which was laid was from Suez to India, a distance of 3,500 miles, in 1859. This cable was laid in five sections, which worked from six to nine months each, but was never in working order from end to end

The total length of all the cables which have been laid is about 70,000 miles, of which over 50,000 miles are now in successful operation. The 20,000 miles of cables which have thus far failed represents 58 in number. Up to 1865, none of them had been tested under water after manufacture, and every one of them was covered with a sheathing of light iron wire, weighing in the average only about 1,500 pounds per mile. These two peculiarities are sufficient to account for every failure which has occurred. No electrical test will show the presence of flaws in the insulating cover of a wire, unless water or some other conductor enters in the flaw and establishes an electrical connection between the out-

side and inside of the cable; and all cables laid in shallow water should have an armor weighing not less than five tuns per mile.

The core of long submarine cables generally consists of several wires of pure copper covered with alternate layers of gutta percha and Chatterton's compound, the latter consisting of gutta percha, resin, and Stockholm tar. Over this is placed a layer of tarred yarn, and the whole is finally included i a sheathing of iron wire laid on spirally, to give the cable sufficient strength to withstand the

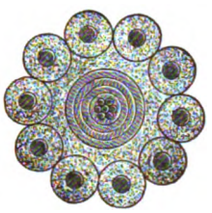


Figure 3.

strain of paying out, or that to which it may be subjected by the inequalities of the ocean bed. Not infrequently the iron wire of the sheathing is also protected from corrosion by tarred hemp. Figs. 1 and 2 show the construction of the Malta and Alexandria cable. The different layers are so far peeled off as to show the construction. The strand of seven copper wires is shown at the top; then follow three layers of gutta percha and one of tarred yarn, the whole enveloped in the eighteen wires constituting the sheathing. The diameter out in the sea is

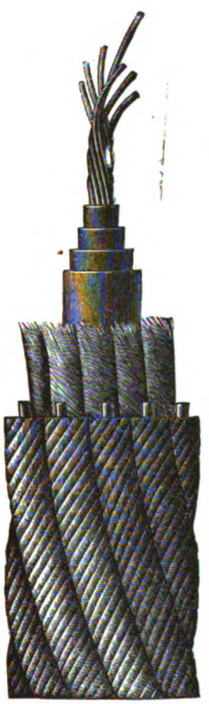


Figure 4.

0.85 of an inch. Near the shore the sheathing is made stronger, to meet the danger of accident from the dragging of anchors.

Including the original 1858 cable, five cables have been laid down between Ireland and Newfoundland, of which only three are now in working order. These three were laid in 1866, 1873 and 1874. The cable of 1865, of a similar type as the above, has not been working for over two years.

The following are the details of construction of the last four Ireland and Newfoundland cables: Fig. 3 shows the section and Fig. 4 the external appearance and construction of the 1865 cable in the full size, 1⅛ inch in diameter. Fig. 5 shows the shore end in section. The construction of the 1865 cable is the same as that of all the subsequent ones, with one or two non-essential differences.

The conductor of this cable consists of a copper strand of seven wires, six laid round one, and weighing 300 pounds per nautical mile, imbedded, for solidity, in Chatterton's compound. Gage of single wire, 0·048 of an inch; gage of strand, 0·144.

The insulation of each cable consists of four layers of gutta percha, laid on alternately with four thin layers of Chatterton's compound. The diameter of core (conductor and insulation) is 0·464 of an inch.

Its external protection consists of ten steel wires, 0·095 of an inch in diameter, each wire surrounded separately with five strands of tarred manilla hemp, and the whole laid spirally round the core, which latter is padded with tarred jute yarn. The weight in air is 35 cwt. 3 qrs. per nautical mile; weight in water, 14 cwt. per nautical mile. Any of the cables would bear eleven knots of itself in water without breaking.

When a telegraph wire at a distant station is disconnected from the ground and placed in con-

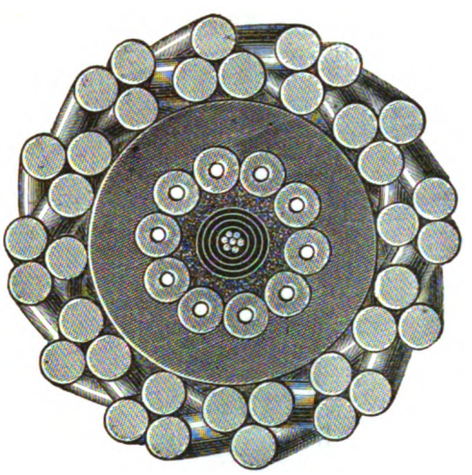


Figure 5.

nection with one of the poles of a battery, the other pole of which is to earth, a charge flows into the wire at the instant in which the connection is made and, if the insulation of the line is perfect, almost instantly ceases. The needle of the galvanometer makes a sudden deflection, and then returns to its position of rest. If the battery is cut off and the line, at the same moment, put to earth, the needle deflects momentarily in the opposite way, and the charge given to the wire returns and goes to earth. In land lines, this return charge is very slight except upon very long lines, but in submarine cables it is very marked. This return charge shows that a telegraph wire may be charged like a Leyden jar. The wire is the inner coating, the air or gutta percha the dielectric, and the earth or sea the outer coating. The statical charge of which a line of telegraph is then capable shows that the electric force tends to propagate itself not only longitudinally but laterally. The effect of lateral induction is to retard the time of delivery of a signal and to prolong it, so that, although it is a momentary signal at starting, it becomes a prolonged signal at its destination. The mere slowing of the signal would not matter much, provided it was delivered at its destination as sent; but it is not. Each signal at the receiving station takes a longer time to leave the line than it did to enter it. Hence, in a cable, if the sender transmitted at the same rate and with the same apparatus that he does in land lines, the signals would run into each other at the receiving station, and be indistinguishable. Time must be given to allow each signal to ooze out of the cable before another is sent. Retardation increases with the square of the length of the l[illegible] The maximum speed of signaling through 2,000 miles of the Atlantic telegraph of 1858 was two and a half words a minute. The copper core had a conducting power somewhat higher than a No. 4 iron wire. If the ratio of the thickness of the core to that of the insulating coating be kept the same, the number of words that can be sent varies as the amount of material employed, or as the square of the diameter of the cable. Thus, if a cable be of the same make and of equal length as another, but twice as thick, four times as many words may be sent by it.

The conductor of the Atlantic cable of 1858 consisted of a strand of seven copper wires of No. 22½ gage, weighing 93 pounds per mile, while those of 1865, 1866, 1873, and 1874 have each 300 pounds per mile. The highest rate of speed obtained through the 1858 cable was 2½ words per minute, while through the 1865, 1866, 1873, and 1874 cables they have obtained a speed of 17 words per minute in regular working, and of 24 words per minute upon an experimental test.

Spectra of Lightning—*Th. Hoh.*—I never saw the spectral phenomena produced by lightning, first described by H. Kundt (*Pogg. Ann.*, Bd. cxxxv., p. 325), so beautifully and distinctly as in a violent storm which passed over Bamberg, April 23rd, between 5 and 6 P.M., in a direction from W.N.W to S.E. My apparatus was a small "direct vision" spectroscope, of 9 c.m. in length (without telescope), the slit of which was open about ½ m.m. Turning to the quarter of the heavens where the lightning was to be expected, I saw first the spectrum dark, but still distinct in its colors, with the strongest Frauenhofer lines. Three or four times there appeared in the yellow and green a diffused, but recognisable illumination, followed each time by thunder within ten to fifteen seconds, and probably due to sheet lightning. Afterwards I observed ten times the spectrum of lightning. In three cases the phenomenon consisted merely of a bright illumination and expansion of the green zone over a part of the blue. In two there was a well-defined appearance of the yellow sodium line, and a fainter one in the red. In the other five cases there were distinct and brilliant lightning spectra, of linear form and rare beauty. Before the splendor of the fine lines the local colors certainly vanished, but their position could be distinctly perceived. I believe that I always counted two to three lines in the red, one each in the yellow and the orange, three or four in the green, sometimes one in the violet. An intense flash, about 20 minutes before 6, which set fire to the town, showed, in addition to the above, a group of five lines in the blue.

The Correlation of Forces.—Of the various forms of energy existing in Nature, any one may be transformed into any other, the one form appearing as the other disappears. This is what is meant by "the correlation of forces." Thus the rotary power of a wheel, if applied to turn a magnet, is converted into electricity; and this electricity, if employed to drive a wheel, is changed back into rotary power.

THE PRUSSIAN TELEGRAPH SYSTEM.

On the occasion of the twenty-fifth anniversary of the Prussian telegraph system, which was first thrown open to the public on the 1st of October, 1849, the Director of Prussian Telegraphs, Major-General Meydam, has published a short historical review on this subject, from which we take the following data:

A line of optical telegraphy was established so early as 1832, between Berlin, Magdeburg, Paderborn, Cologne, Coblence and Treves, which was worked under the supervision of the Ministry of War, and was conducted by Major (later General) von Etzel as director. Its organization was military, and it served only for the transmission of political and military news. On its extension and changed destination the Minister of War had mooted its separation from his department. The director of the optical telegraph left the service in 1848, and was succeeded by his son, Major of the General Staff (now General of Infantry), von Etzel, and his successor, in 1849, was Colonel du Vignau. The latter was, at the same time, appointed Chairman of the Telegraph Commission, which acted under the Ministry for Commerce, Trade and Public Works, and eventually resulted in the Royal Telegraph Direction. This was formally instituted an independent department by royal order of 23d of May, 1849. The optical line of telegraph between Berlin and Cologne was abolished as obsolete, the electric telegraph was introduced in its place, and the suitable military officials became civil employés.

On the 4th of December, 1851, Major of Engineers Chauvin was appointed Director of the Telegraph Department. Unfortunately, in the following years the introduced subterranean telegraph lines failed so often that it was found necessary, if telegraph communication was to be kept up, to make them all overground ones. After an experimental introduction in the autumn of 1851 of an overground line of telegraph, the change of the existing underground lines into overground ones, in which galvanized iron wire, isolated by porcelain bells, was carried on poles, was taken in hand in 1852. At first Berlin was connected only with the principal cities and such towns as possessed exchanges of the provinces and neighboring States, regard being had to the requirements of each Government, so that but few stations were opened, only ninety-seven at the end of 1857. Although it was soon evident that the existing lines were insufficient for the requirements of the public, it was not until after 1858 that a serious attempt was made to extend the lines, so as to cover the country with a complete network. Originally the chief telegraph lines started from the Berlin termini of the respective railways, but in 1850 part of the building in which the General Post-Office at Berlin was located was fitted up as a central telegraph station; and when these premises became too narrow for the extended business, a separate building was constructed, in which the Central Telegraph Station, and the Telegraph Administration have had their domicile since 1864.

The tariff was in the first years of telegraphic communication regulated by a graduating scale, and was pretty high. The lowest charge was 2s. for a telegram of twenty words; one from Berlin to Hamburg cost then 6s., which sum will now cover the charge for a telegram from England to almost any country in Europe. A telegraph from Memel, at the eastern extremity of the Prussian monarchy, to Aix-la-Chapelle, at the western, cost then 12s. With the year 1858, however, a change for the better took place, the rates uniformly lowered, the above-mentioned charges being reduced to 1s. 2½d., 3s., 7s., and 7s. 2½d. respectively.

Of great service, as we all know, has been the telegraph to Prussia during the wars of the last ten years. Under the co-operation of the Telegraph Administration, the Prussian Ministry of War had organized a movable field telegraph for the use of the army in the field along with an efficient corps.

Always careful with regard to its army, the Prussian Government laid the foundation of its army telegraph corps during peace; materials for the construction of light field telegraph lines and temporary stations, as well as the carriages necessary for transport, were accumulated, to serve at once at the mobilization of the army in forming field telegraph sections. Two such sections were already in operation during the Danish war, and proved exceedingly useful. In the campaign of 1866, the army telegraph corps consisted of four sections: one for the general staff, and one each for the three separate armies (the Silesian, the Bohemian and the Main). In both wars the Director of Telegraphs, Colonel von Chauvin, was conducting the operations of the telegraph corps on the respective seats of war. By Article 48 of the North German Constitution, the Telegraph Administration was empowered in 1867 to take under its supervision all the telegraphy lines of the different States. The position of the Telegraph Department was still further confirmed by an order of the Federal Council of the 18th December, 1867, by virtue of which the Administration of the Postal and Telegraph system of the North German Confederation was divided into two branches, the "General Post-Office of the North German Confederation," and the "General Direction of Telegraphs of the North German Confederation," both divisions being subordinate to the Imperial Chancellor. The Director of Telegraphs, Colonel von Chauvin, was appointed Director-General of Telegraphs of the North German Confederation.

The organization of the existing telegraph administrations into a complete whole required extensive administrative and technical labor. The lowering of the rates from 10¾d., 1s. 7¼d., and 2s. 5d., to 6d., 1s., and 1s. 6d. respectively, into the three different zones into which the distances were divided, although it had the effect of increasing telegraphic correspondence, did not result in the expected surplus with which it was intended to cover the outlay for the extension of the lines of telegraph, and an increased number of stations. The expenditure for this object had therefore to be provided from other parts of the revenues.

The efficiency of the German telegraph was severely tried in the late Franco-German War. Seven field and five *étappe* telegraph sections were in operation, under the command of Colonel Meydam, (since the beginning of 1870 the repreeentative of the Director-General), who during the war was attached to the general staff. Two Bavarian field telegraph sections, and one attached to the Würtemburg contingent, co-operated with those of the North German Army.

After the definitive constitution of the German Empire, its telegraph system was organized as one department, and has since been so represented in its relations with other countries, though the Bavarian and Würtemberg telegraph administrations still exist in their integrity.

The first Director-General of Telegraphs of the German Empire, Major von Chauvin, resigned in 1872 on account of his health, which had been shattered during a period of the most laborious exertions in his sphere, and his successor is Colonel, now Major-General Meydam (the author of the memoir of which this is a *résumé*), formerly chief of the Department for Engineering in the Prussian Ministry of War, who had been Von Chauvin's representative since 1870.

CHEAP TELEGRAPHY.

(From the Scientific American.)

President Orton's report of the affairs of the Western Union Telegraph Company is not calculated to inspire much hope in those who believe that the government can run the lines at cheaper rates to the public. On the 1st of January, 1873, a reduction of more than fifty per cent. was made in the maximum tariff between the most remote points on the company's lines. This, though occasioning a temporary loss of revenue, has resulted, during the last few months, in a large increase. The reduction was from $7.50 and $5 to $2.50. President Orton now adds that, owing to Messrs. Edison's and Prescott's quadruplex apparatus, which is, at the present time, working successfully between Chicago and New York, and by which two messages are sent in the same direction and two more in the opposite direction simultaneously on a single wire, he believes it practicable before long to cut rates down still lower, and ultimately to establish but four rates for day messages, namely, twenty-five, fifty, seventy-five cents, and one dollar, with half charges (except for the lowest) for night messages.

THE WESTERN UNION DENVER OFFICE.

No handsomer headquarters for ye electric paraphernalia can be probably found for a thousand miles, and in any direction, than those recently occupied by the Western Union Telegraph, in this city. The office is now in the second story of Woodward's Block, on Holladay street, which has been fitted up for the purpose, with all the modern improvements. It possesses three improved tables, on each of which four instruments are mounted, affording an aggregate of twelve keys, on which to transmit and receive messages. Everything about the office in the way of furniture and fixtures is new, and it is lighted splendidly by three immense windows.

The enterprise of the Company in affording such a pretty place for Denverites to do their telegraphing in is only on a par with that which has all along induced it hereaway to plant telegraph stations in advance of settlements. All this western country has been particularly favored by this great corporation in this respect, and also in the care which it has taken to make the lines thus established durable, by using cedar poles in place of the wood ordinarily used for that purpose.

Mr. B. F. Woodward, as nearly everybody in Denver knows, is the manager for the Company here, and he is in command of a comparatively large and capable corps of operators.—*Rocky Mountain News.*

AN EXPERIMENT WITH SILVER.—Bœtger offers the following experiment to show the formation of binoxide of silver and metallic silver by electrolysis: A concentrated solution of nitrate of silver is placed in a wide glass cylinder, and two platinum wires, forming the poles of a galvanic battery, are placed in the solution in a vertical position, about three inches apart. Beneath the anode is placed a small watch glass, and the current from two Bunsen cells started. In a few minutes brilliant needles of binoxide of silver appear on the anode, and, becoming too heavy to remain unsupported, fall on the watch glass beneath. On the cathode an equivalent quantity of pure metallic silver collects in snow white dendritic ramifications.

CORRESPONDENCE.

To the Editor of the Journal of the Telegraph:

The solutions of the problem of the combined resistance of bridge circuits, furnished by Messrs. Hamilton and d'Infreville, are correct as published in the JOURNAL. The London *Telegraphic Journal* also published the same solution of this problem. All of these are based on what are known as Kirchoff's laws. The same result, however, may be attained in another manner quite independent of Kirchoff's laws.

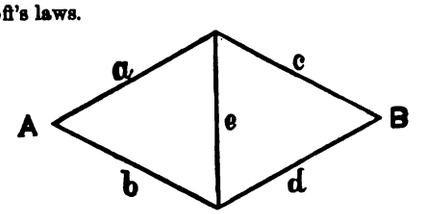


FIGURE 1.

There are three paths for the current from A to B, Fig. 1. 1st, through a and c; 2d, through b, e and c; 3d, through b and d. If these paths can be arranged so that each is independent of and separate from the others (as represented in Fig. 2), the question is reduced to the simple one of finding the combined resistance of three conductors.

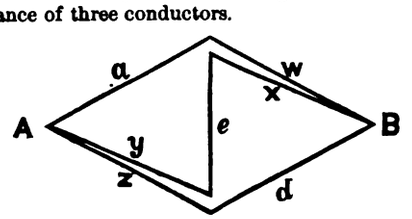


FIGURE 2.

Imagine the sections b and c (Fig. 1), each split longitudinally into two conductors, and one of each connected, as shown in Fig. 2, to the two ends of e. Call the two parts of c, w and x, and the two parts of b, y and z. The combined resistance of w and x must equal c, and that of y and z must equal b; from which the two following equations are obtained:

$$\frac{w\,x}{w+x} = c \quad (1)$$

$$\frac{y\,z}{y+z} = b \quad (2)$$

Again, the potential at the point of junction of z and d must be the same as at the junction of y and e. To effect this the resistance y must bear the same proportion to z as $e+x$ to d. This gives:

$$\frac{y}{z} = \frac{e+x}{d} \quad (3)$$

In the same manner the potential at the junctions of a with w and e with x being equal:

$$\frac{a}{y+e} = \frac{w}{x} \quad (4)$$

From these equations the following value of the unknown quantities w, x, y and z is obtained:

$$w = 3{,}818\tfrac{2}{11}$$
$$x = 4{,}200$$
$$y = 2{,}300$$
$$z = 1{,}769\tfrac{2}{13}$$

By substituting these values in Fig. 2 it will be evident that the question is simply to determine the joint resistance of three circuits, *i. e.:*

$$a+w = 6{,}818\tfrac{2}{11}$$
$$y+e+x = 7{,}500$$
$$z+d = 5{,}769\tfrac{2}{13}$$

and the result is $2{,}205\frac{1}{4}$,

A. S. BROWN.

W. W. W.—The matter will be promptly investigated. D. H. B.

To the Editor of the Journal of the Telegraph:

I have a private telegraph line, 30 miles long, running to my central office at Worcester. The main wire is worked with 10 cups, carbon battery, and works well.

To work our register we use 3 cups vitriol battery, such as is usual for locals. With this we find this trouble. If we leave the register on, in one hour it will run the battery all out and will have no working power at all, so that if we leave it switched on, so that we can hear the call, it will not stay up one hour, and we are obliged to cut it off and trust to the relay for the call, and switch it on when we wish to run the register. We have procured entire change of battery, cups and all, and it still is the same.

Now, can you tell us what is the matter. I am of the opinion that, if we were using it quite constantly, it would keep up, for I have noticed that when I found it quite weak and commenced to use it it would gradually come up; but we cannot use it constantly, but must leave it connected and at rest until we wish to use it.

No telegraph operator I have consulted can account for it. Will you tell us? L. J. K.

Answer.—The current strength obtained with a battery of given surface is at its maximum when the plates are so divided that the internal resistance of the battery is equal to that of the circuit.

In accordance with the law, as above, the resistance of your register coils should equal that of the internal resistance of the local battery. This may be properly arranged, and yet the proportions be made to vary, producing the trouble you experience, from the following causes:

1st. The platina points on the relay armature may be too soft. This would cause a very rapid oxydization, which, when accumulated, would cause a resistance sufficient to destroy the magnetic power in the register magnet. On removing the local circuit for a while, the points would, by the vibrations of the relay armature, clear themselves, and, on making local contact again, work well until they became again oxydized.

This may be remedied by burnishing the points occasionally.

2d. A defect may exist in the coils of the register magnet by which a great part, or the entire wire surrounding the core, may be cut out by the jar of the register lever.

Three cells of No. 1 gravity battery, of about 1½ ohms resistance per cell, would be more constant and work satisfactorily.

HOOSICK FALLS, N. Y., Dec. 16, 1874.

To the Editor of the Journal of the Telegraph:

Please answer the following question in your next issue, and oblige: A customer comes into my office and writes a letter to R——, who lives five miles from the telegraph office. Customer desires to have the message delivered by messenger, and writes in the body of message, "deliver by messenger—charges guaranteed," and deposits the amount of money with me that I think will defray the expenses of delivery. In counting the number of words, I count deliver by messenger—charges guaranteed, and charge for those words. My repeating office thinks that I should not do so. Am I right or wrong? Remember those extra five words were not in the address, but body of message.

P. MCKEOWN, Manager.

Answer.—You were right in charging for the extra words. It would also have been right to have charged for them had they been in the address or in any other part of the message.

ST. JOHNSBURY, Vt., Dec. 9, 1874.

To the Editor of the Journal of the Telegraph:

Please inform me through the JOURNAL how many words in the following message:

"Ship one car corn, Coaticooke, Province of Quebec."

I claim that "Province of Quebec" should be counted as two words, as it is given to designate a place; the word "of" being counted as one word, and "Province Quebec" one word. OPERATOR.

Answer.—You are incorrect. Province of Quebec are three words.

VICTORIA, B. C., Dec. 11, 1874.

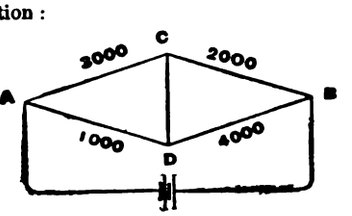
To the Editor of the Journal of the Telegraph:

Are there more than fifteen words in the following message: "What freight would be safe calculate; tendering for seven millions feet railroad ties, Cape of Good Hope. Reply?"

And has a repeating office, through which a message of this kind, checked "15 paid," passes, a right to alter the check to read 17 words? A. L. M.

Answer.—There are seventeen words. It is the duty of all offices, repeating or otherwise, to transmit and receive messages in a correct and proper manner. The number of words must correspond to the check.

MR. D'INFREVILLE offers the following problem for solution:



Resistance between A and B being equal to 2,100, required the resistance between C and D.

MEASUREMENT OF GALVANIC CURRENTS.—Mr. Latimer Clark states, in reference to a common source of error in the measurement of currents of short duration, that when using galvanometers with shunts, a certain discrepancy has been noticed, which is usually attributed to some peculiarity of the vibration of the needle of the galvanometer; and on endeavoring to ascertain the cause of this discrepancy, he discovered that the results given by the use of resistance coils were correct, and that those obtained by the use of condensers were wrong. The cause of the error he traces up to the fact that the movement of a magnetic needle tends to induce in the coil within which it is suspended a current in the opposite direction to that producing its deflection. A larger proportion of the whole current consequently passes by the shunt, which is not subject to the influence of the needle. If, therefore, two galvanometers are used, the movements of the needles within their coils being similar, each of them counteracts the other's influence, thus concealing the errors of the process. This source of error does not exist when the measure is made by a differential galvanometer. De Sauty's method of comparing measures is also free from this source of error, and, in general, he concludes that it is better in testing submarine cables to avoid the use of condensers for comparing batteries with standard cells, and to make use rather of very high resistance coils; and he has generally recommended the use of a resistance as high as 250,000 ohms.

IN an ordinary open fire grate 75 per cent. of the heat resulting from the combustion of the fuel goes up chimney and is wasted, only 25 per cent. being radiated into the apartment.

WESTERN AND BRAZILIAN TELEGRAPH.

The report states that the several sections of the Company's cables were completed as follows: Para to Pernambuco, 6th September, 1873; Pernambuco to Bahia, 11th December, 1873; Bahia to Rio de Janeiro, 24th December, 1873. These cables are all in thoroughly satisfactory working order. Owing to the unfortunate loss of the steamship Gomos in May last, and the lamentable wreck of the Plata, lately reported, communication has only been extended to Rio Grande do Sul southwards by the Platino-Braziliera Company. Arrangements are, however, in progress for the speedy completion of the short section still unlaid, which, when finished, will complete cable communication with the River Plate. The shareholders are aware of this Company's agreement with the Platino-Braziliera Company, by which all the cables between Rio de Janeiro and Montevideo, when laid, become our property. In connection with this agreement the Directors have to report that, pending the completion of the said cables, they have agreed to pay the Platino-Braziliera Company 5 per cent. of the gross earnings since the opening of their line from Rio de Janeiro to Rio Grande (that is, the 1st May last), in full of all claims of participation in traffic by the Platino-Braziliera Company. Upon completion of their line as above the agreement of the 23d of May, 1873, will come into force. The cables of the Central American Telegraph Company, between Para and Demerara, have been laid to Cayenne, and the necessary cable to complete the communication has left England. The extension of cable communication to the River Plate and the opening of the lines between North and South America will undoubtedly prove additional sources of revenue to this Company. Working agreements have been completed with the Brazilian Submarine Company, the West India and Panama Company, and the River Plate Company, by which all traffic passing over the lines of these companies for South America is secured to this Company. Although for some months only one section of the cable was laid and at work, and communication with Europe was not opened until the 22d June, 1874, from the opening of the line in September, 1873, to the 30th September last, the total amount of receipts was £70,473, of which £43,917 belong to this Company. From that date the receipts continue very satisfactory, being £23,298 up to the 4th inst.

THE EASTERN TELEGRAPH COMPANIES.

The general meetings of the Anglo-Mediterranean, British Indian, and Falmouth, Gibraltar, and Malta Submarine Telegraph Companies, were held in London, on Thursday Dec 10th, when the final reports of the liquidators were presented and formally passed. The liquidators report that all the concessions, property and liabilities of these companies have now been transferred to the Eastern Telegraph Company, and that the affairs are fully wound up in accordance with the terms of the special resolution of the 3rd October and 1st November, 1872, upon the basis of which the Eastern Telegraph Company was formed, and these companies placed in liquidation.

The Chairman said the meetings were purely formal to confirm the amalgamation of the different companies, which have been united under the head of the Eastern Telegraph Company. He might state that these amalgamations were brought about at the instance of the different shareholders, and there was as yet no reason to regret what had been done. They now did all the work under one Board, and although the dividends had not been increased, nor any immediate economy effected, still the arrangement was so far satisfactory.

A Shareholder asked why the liquidation of the Marseilles Company was still incomplete.

The Chairman said that the reasons arose from negotiations going on with the French Government in regard to a direct line through France. There had been considerable difficulty in bringing this about, but he was glad to say that only that morning the necessary assent had been received. The Marseilles report and accounts would now be submitted for passing in due course. The chairman concluded with a few observations on the national importance of submarine telegraphy.

A vote of thanks concluded the business.

Eastern Telegraph.—The Company announce that agreements have been completed with the French Government, her Majesty's Postmaster-General, and the Submarine Telegraph Company, by which they will be immediately placed in possession of a special wire between London and Marseilles, to be worked by the Company's own clerks. The new line is designed expressly for the traffic between Great Britain and Egypt, and the transit of messages will now be greatly accelerated.

In consequence of the loss of the La Plata, the cable steamer Sydney Hall, under charter by the Montevidean Brazilian Telegraph Company, to proceed to the River Plate to complete the communication in concert with the La Plata, is detained in the Thames until another steamer can be despatched by the Platino Braziliera Company.

The Directors of the Anglo-American Telegraph Company have resolved to pay the usual interim dividend of 1¼ per cent., free of income tax, for the quarter ending December 31st.

The Directors of the Brazilian Submarine Telegraph Company have declared an interim dividend for the quarter ending September 30 last of 2s. 6d. per share, or 5 per cent. per annum, free of income tax, and payable on Thursday, December 24th.

The Directors of the Eastern Extension, Australasia, and China Telegraph Company declared a dividend for the quarter ending September 30th of 3s. per share, or 6 per cent. per annum, free of income tax, payable on January 15th.

The Eastern Telegraph Company announces that the usual interim dividend of 2s. 6d. per share, in respect of profits for the quarter ending 30th September last, will be paid on and after 14th January next.

The traffic receipts of the Eastern Telegraph Company for November, 1874, amounted to £33,060, as against £35,096 for the corresponding period of 1873; and those of the Eastern Extension Telegraph Company for the same month amounted to £17,728, as against £17,454 for the corresponding period of 1873.

The foundering of the steamer La Plata with a portion of the Brazilian cable on board will, it is stated, involve a total loss to the underwriters of £100,000. In the case of the Gomos, which was wrecked a short time since, the loss has, up to the present time, been only partially settled. The total liability will, it is reported, be about 35 per cent. of the whole sum insured.

The total number of messages forwarded from postal telegraph stations in the United Kingdom during the week ending December 5th was 354,418, and during the week ending the 6th of December, 1873, 339,099, showing an increase in the week of 1874 on that of 1873 of 15,319.

PROPOSED REFORM IN THE BRITISH PATENT LAWS.

We see it stated that the Lord Chancellor of England has intimated his willingness to receive a deputation on the Patent Laws, and to consider the bill in which the proposed reforms are embodied. The chief points are reduction in the cost of the Letters Patent, a simplification in the manner of obtaining them, and amendments in the legal proceedings for repression of infringement. A general reform of the Patent Office and of the arrangements of the Patent Museum will also be proposed.

Galvano-Plastic Coppering of Cast-Iron Rollers for Calico Printing.—*G. Schæffer.*—Many attempts have been made in this direction by Lokett (Lockett ?), L. Huguenin, and Schlumberger. One of the defects of the coppered rollers was that they were capable of losing their true form—an accident easily remedied upon a cylinder of copper, but not upon those of coppered iron. Th. Schlumberger cleanses the iron cylinders with a concentrated alkaline lye, washes well in water, and goes over the whole surface with the file. The surface is then very bright, and is not to be touched with the fingers or soiled with the breath. It is then plunged in an alkaline bath composed of—

Sulphate of copper	1 part.
Dissolved in water	12 parts.
Cyanide of potassium	3 parts.
Carbonate of soda	4 "
Sulphate of soda	2 "
Dissolved in water	16 "
Or, Ammonia	3 parts.
Acetate of copper	2 "
Dissolved in water	10 "
Cyanide of potassium	3 parts.
Carbonate of soda	4 "
Sulphate of soda	2 "
Dissolved in water	10 "

The cylinder is allowed to remain twenty-four hours in one of these baths, subject to the action of a battery of 4 or 6 pairs, till the surface is coated with a slender bnt adherent layer of copper. It is washed and cleansed with pumice-stone. If in this operation the iron should be laid bare in any part, the cylinder must be anew submitted to the alkaline bath. As soon as the coating of copper is uniform it is washed in acidulated water, and immersed in an acid bath of sulphate of copper. This bath is composed of solution of copper at 20° B., to which 1-300th of its volume of sulphuric acid is added to facilitate the solution of some metallic copper, which is also immersed in the bath for the purpose of maintaining the solution in an uniform state of concentration. Here the cylinder is left till the layer of copper has attained the desired thickness, a galvanic current being kept up by a battery of four pairs. If the temperature is between 15° and 18°, three to four weeks are required to produce a deposit of three-quarters of a millimetre in thickness. The cylinder is turned one-quarter round daily to change the portion of its surface which faces the sheet of copper used as a positive electrode.

Pyrometers.—It appears from a report of a committee charged with examination of the above instruments, that, by means of the Siemens electric pyrometer, changes of resistance amounting to about $\frac{1}{10000}$ of the quantity of heat to be measured can be detected without much difficulty.

The traffic receipts of the Western and Brazilian Telegraph Company, for the four weeks ended Nov. 20th, were £9,076.

TARIFF BUREAU.

SEMI-MONTHLY CIRCULAR.

EXECUTIVE OFFICE,
WESTERN UNION TELEGRAPH COMPANY,
145 Broadway, New York, January 1, 1875.

To all offices on W. U. Lines:

The following changes and additions have been made since the date of the last circular:

GENERAL INFORMATION.

Chehaw, Ala., re-opened, square 267.
Notasulga, Ala., closed.
Le Claire, Iowa, closed.
The P. O. A. of York, Me., is York Corner.
Hereafter the "tariff for other lines" to Morgan, Marquette Co., Mich., will be 150 and 10 from Chicago, Ill.
Porter, Mich., changed to Stephenson.
Hobart, Minn., changed to Frazee City.
Hereafter the "tariff for other lines" to Sleepy Eye, Minn. will be 125 and 8 from Chicago, Ill.
Fort Benton, Mon., closed.
Lebanon, N. J., re-opened, square 52.
Messages taken for Fairton, Cedarville, Dividing Creek, New port and Mauricetown, N. J., are delivered by train leaving Bridgeton, N. J., twice daily. Charges for delivery 25 cents.
Athens, N. Y., closed.
Assametquagan, Que., closed.
Allegheny Depot, Va., closed.
Bloom, Wis., changed to North Freedom.
Hereafter the "tariff for other lines" to Horicon, Reedville and Shiocton, Wis., will be 40 and 3, 60 and 4, and 70 and 5 respectively, from Chicago, Ill.

NEW OFFICES.

* Florence, Arizona.,	100	8	San Diego, Cal.		
Cana Station, Cal.					
Greenville, "					
Taylorville, "					
598 Hall's Gulch, Col. P. O. Grant.					
* Fort Lincoln, Dac.,	200	13	307	Chicago, Ill.	
* Stephenson, Mich., (formerly Porter),	100	7	307	"	"
* Black Hoof, Minn.,	150	10	307	"	"
* Dakotah, Minn.,	75	5	307	"	"
* Frazee City, Minn. (formerly Hobart),	150	10	307	"	"
* Minnetonka Mills, Minn.,	125	8	307	"	"
* Swede Grove, Minn.,	150	10	307	"	"
* Sandy Creek Junc., N. Y.,	25	1	57	Utica.	
180 Easton, O.					
* Anderdon, Ont.					
* Charlemagne, Que.					
* St. Flavie Station, Que.					
* Eagle Ford, Texas,	25	2	511	Dallas.	
* Belgium, Wis.,	35	2	307	Chicago, Ill.	
* Cato, "	60	4	307	"	"
* Grimms, "	40	3	307	"	"
* Knowlton, "	75	5	307	"	"
* Mosinee, "	75	5	307	"	"
* North Freedom, Wis. (formerly Bloom),	60	4	307	"	"
* Port Edwards, "	75	5	307	"	"
* Oostburg, "	35	2	307	"	"
* Sherman, "	35	2	307	"	"
* Wausau, "	75	5	307	"	"
* Weston, "	75	5	307	"	"
* Whitehall, "	100	7	307	"	"

The rate to square 574 from offices in the following States, is $2.00:

Arkansas, Kentucky,
Illinois, Minnesota,
Indiana, Missouri,
Iowa, Tennessee,
Wisconsin.

TO OFFICES HAVING "SHEET C."

Offices in squares 297, 306, 307 and 316, which have "Sheet C," will make the following changes in their rates to the squares of the North Western Telegraph Company given below:
From 297 to squares 32, 38, 40, 41 and 46, ONE DOLLAR.
From 306 to squares 41, 46, 47 and 50, ONE DOLLAR.
From 307 to squares 38 and 40, ONE DOLLAR.
From 316 to square 41, ONE DOLLAR.
These changes to take effect JANUARY 11th, 1875.

Add the following offices in Minnesota and Wisconsin to your Sheet C, and check accordingly.

50 Castle Rock, Minn.		41 Knapp,	Wis.
55 Cokato, "		29 Lafayette,	"
38 Dakotah, "		16 Lima,	
41 Etter, Minn.		29 Lowery's	Wis.
55 Howard Lake "		38 Marshland,	"
38 La Moille, "		15 Medina,	"
59 Nicollet, "		24 North Freedom,	"
64 Swede Grove, "		9 Oostburg,	"
56 Wells, "		25 Port Edwards,	"
38 Arcadia, Wis.		23 Remington,	"
32 Blair, "		17 Richwood,	"
9 Belgium, "		46 Roberts,	"
10 Fort Howard, "		18 Royalton,	"
7 Grimms, "		9 Sherman,	"
18 Junction City, "		10 Shiocton,	"
29 Kendalls, "		32 Whitehall,	"

St. Cloud, Minn., will hereafter be in square 55.

ATLANTIC CABLE BUSINESS.

We are notified that the cable between England and Guernsey (Channel Islands) is broken. Messages for the Channel Islands are sent via France only. Tariff $1.88 for twenty words or less, in addition to the ten-word rate to London.

The cable between Singapore and Batavia is repaired, and communication restored.

CUBA CABLE BUSINESS.

The cable between Kingston and Aspinwall is again in working order.

WILLIAM ORTON,
President.

EXECUTIVE OFFICE
WESTERN UNION TELEGRAPH COMPANY,
NEW YORK, Dec. 26th, 1874.

Executive Order No. 158.]

GOVERNMENT MESSAGES.

Official messages of officers or agents of the United States will hereafter be transmitted, "paid" or "collect" at the option of the sender, priority being given them over all other business.

The tariff upon such messages will be 25 cents for 25 words or less, and one cent for each additional word for each circuit of two hundred and fifty miles or fractional part thereof.

All the words, except the date and place where the message is filed, will be counted, and the distances will be computed by the tables of the Post-Office Department. If payment of a collect message is refused, delivery will be made nevertheless, and a report of non-collection immediately made by mail to the Auditor only. Credit will be taken for the uncollected tolls in the monthly account current, and a copy of the message returned as a voucher.

This order does not apply to such weather reports as are transmitted over scheduled signal circuits, the manner of returning which is specially provided for.

Executive orders Nos. 125 and 144 are hereby revoked.

WILLIAM ORTON,
President.

EXECUTIVE OFFICE,
WESTERN UNION TELEGRAPH COMPANY,
NEW YORK, Dec. 28th, 1874.

All franks issued by this Company during the year 1874, and now in force, are hereby extended until the 31st day of January, 1875.

GEO. H. MUMFORD,
Vice-Pres't.

TRANSFER SERVICE.

EXECUTIVE OFFICE,
NEW YORK, Dec. 26th, 1874.

On and after January 1st, 1875, Greece City, Pa., Fagundus, Pa., and Shamburg, Pa., will be discontinued as money order offices.

GEO. H. MUMFORD,
Vice-Pres't.

THE TELEGRAPHERS' MUTUAL BENEFIT ASSOCIATION.

RECEIPT OF ASSESSMENTS—NEW YORK, DEC. 24, 1874.

ASSESSMENT NO. 71.

23, 29, 31, 52, 54, 59, 60, 64, 67, 72, 75, 82, 88, 89, 95, 99, 103, 108 114, 129, 140, 141, 142, 144, 148, 158, 189, 190, 191, 193, 197, 198, 230 254, 269, 278, 279, 281, 282, 283, 285, 312, 342, 344, 346, 351, 352, 361 367, 372, 378, 379, 391, 394, 405, 426, 430, 431, 466, 468, 469, 470, 471 475, 514, 533, 542, 546, 554, 555, 560, 579, 586, 603, 661, 672, 678, 680, 685, 714, 729, 734, 740, 742, 750, 751, 756, 764, 769, 787, 791, 799, 812, 831, 855, 859, 873, 874, 875, 883, 886, 906, 917, 929, 932, 943, 952, 977, 978, 1023, 1038, 1040, 1047, 1072, 1088, 1090, 1093, 1102, 1143, 1147, 1169, 1198, 1200, 1226, 1227, 1232, 1233, 1267, 1288, 1325, 1329, 1364, 1365, 1398, 1407, 1417, 1426, 1444, 1449, 1451, 1454, 1455, 1456, 1482, 1484, 1488, 1489, 1498, 1505, 1506, 1507, 1508, 1517, 1522, 1532, 1554, 1555, 1569, 1582, 1589, 1601, 1615, 1620, 1625, 1634, 1652, 1656, 1658, 1676, 1681, 1692, 1697, 1699, 1707, 1721, 1723, 1732, 1733, 1736, 1745, 1775, 1791, 1809, 1810, 1811, 1812, 1847, 1869, 1906, 1919, 1938, 1942, 1957, 1965, 1991, 1999, 2000, 2001, 2025, 2026, 2028, 2029, 2040, 2057, 2061, 2065, 2069, 2084, 2086, 2094, 2097, 2113, 2114, 2138, 2147, 2159, 2162, 2165, 2169, 2170, 2172, 2180, 2181, 2192, 2196, 2197, 2199, 2201, 2203, 2204, 2205, 2206, 2212, 2213, 2216, 2233, 2240, 2242, 2256, 2257, 2263, 2278, 2285, 2288, 2294, 2295, 2296, 2297, 2298, 2299, 2309, 2310, 2313, 2314, 2315, 2316, 2317, 2319, 2321, 2331, 2332, 2339.

ASSESSMENT NO. 69.

6, 175, 273, 294, 347, 597, 692, 766, 1134, 1135, 1136, 1556, 1557, 1570, 1650, 1678, 1722, 1727, 1742, 1778, 1916, 1945, 1946, 1947, 1967, 2063, 2066, 2182, 2190, 2236, 2279.

MISCELLANEOUS.

68.—1854.
70.—398.

Members of the Association who look to the JOURNAL OF THE TELEGRAPH for receipt of assessments paid, will please take notice, that an acknowledgment of the receipt of one assessment should be taken as a receipt for all previous assessments.

PRESENTATION.

On Christmas morning the business men of Bryan, Ohio, presented Miss Olive M. Vineyard, Manager of the Western Union Company's office at that place, with an elegant gold watch and chain as an appreciation of her services and her uniform courtesy and kindness.

EXCELLENT SPORT.

In Peru, where telegraphs are subject to daily interruptions, the inhabitants of the districts traversed by the wires consider it excellent sport to upset the posts and shoot at the operators. At least so says the special correspondent at Lima of the Panama *Star and Herald.*

THE Denver (Col.) *News* takes pleasure in acknowledging the very excellent manner in which the President's Message was transmitted upon the wires of the Western Union Telegraph Company. The management in that city took particular pains in receiving it, and their work was admirably done in all respects.

As showing the extensive use to which the electric telegraph is now applied in the transmission of news for the daily and other papers, it may be stated that one of the Scottish papers—the *North British Daily Mail*—received by wire eight columns of extracts from the Life of the Prince Consort, and which appeared in its columns the morning after the publication of the work.

BORN.

HOWELL.—At Stockton, Cal., Nov. 28, 1874, to L. J. Howell, Manager W. U. Tel. Office, Knight's Landing, a son.

DIED.

MCNABB.—At Washington Heights, Ill., Dec. 9, 1874, Robert J., son of Sebastian H. McNabb, aged 1 year, 7 months and 2 days.

ON THE ELECTROMOTIVE FORCE OF PALLADIUM IN GAS BATTERIES.

(*From The Telegraphic Journal.*)

It was demonstrated by Graham, in one of his latest researches, that palladium has a powerful attractive force towards hydrogen, so that it can condense, in its pores, more than 900 times its own volume of that gas; and further, that the hydrogen thus condensed and combined had a remarkable power of deoxidation, so that it reduces salts of oxide of iron to protoxide salts, and changes red ferrocyanide of potassium into yellow. He conceived hydrogenium (the hydrogen thus combined and condensed) as the active form of that gas, as ozone is of oxygen.

From researches (especially those of Bœtz) on the electromotive force of gas-batteries, it appears that this force depends not only on the opposite affinities of the constituent gases, but also on the power of condensation of the solid bodies forming the electrodes. To this is owing the high electromotive force of a gas-battery with platinum electrodes.

From these data Prof. Villari, of Bologna, was led to anticipate that a gas-battery with palladium electrodes would present a still greater electromotive force than one with platinum electrodes; and his experiments have verified this.

He first tried to compare directly the electromotive force of two gas elements,—one with platinum, the other with palladium electrodes; but secondary actions proved so disturbing that he was forced to reduce the phenomenon to its most simple forms, and then study it. He thus examined, first, the comparative action of platinum and palladium in hydrogen gas; then he compared the action of platinum and palladium in oxygen; and then the action of two gas-batteries.

In reference to the first point it appeared, from repeated experiments (in which two electrodes, platinum and palladium, were immersed in hydrogen), that the palladium was the negative or more readily oxidisable element; and as the two well-polished metals were almost equally unattackable by acidulated water, we must suppose that it is the hydrogen which, in contact with palladium, is more oxidisable than in combination with platinum. This quite agrees with the ideas of Graham. To obtain such experimental results the palladium must be exposed a considerable time to the hydrogen, whether chemically or physicaliy (electrolytically) produced; otherwise very small, and even opposite, deflections may be had, especially with chemically prepared hydrogen. In fact, immediately after contact of the hydrogen with the two electrodes, the hydrogen in contact with the platinum seems the most readily oxidised. This anomaly disappears, however, in a short time, which, in the author's experiments, never exceeded thirty minutes.

It need hardly be said that whenever the palladium is once charged with hydrogen, it is not necessary to prolong the contact of these bodies if they are again to be experimented with, and one may thus, without waiting, change or renew the hydrogen at will. The pallaidum, so charged, may act for a long time as if it were in contact with hydrogen, and appear as oxidisable element, even if quite immersed in acidulated water. To make the foregoing investigation, then, it is necessary to dehydrogenise the palladium, which can be done in several ways.

The action of oxygen in gas-batteries with platinum electrodes is very complicated. Prof. Villari commenced by taking two ordinary glass tubes,—one containing a platinum, the other a palladium plate, both metals well polished,—and giving no current in the galvanometer, when the tubes were filled with acidulated water. He next half-filled both tubes with chemically prepared oxygen, and observed that, after a long time, the galvanometer still remained at zero; whence must be inferred either that the metals had no particular influence on the oxygen, affecting its action in any way, or that the influence in both was the same. To decide this he took two polished platinum wires, which, immersed in acidulated water, gave no current; he then filled one of the two tubes with chemically prepared oxygen, and kept the other filled with acidulated water; a slight deflection appeared, which quickly decreased to *nil*, the platinum covered with oxygen acting some time as electro-positive element. It is therefore clear that an action of this kind, perfectly negligeable, is also to be attributed to the palladium plate covered with oxygen, and it may therefore be affirmed that these metals have no special influence on this gas. This agrees with the already well known fact that neither platinum nor palladium absorb any oxygen when serving in a voltameter as positive electrode. The action of oxygen is, on the other hand, very lively when it is obtained electrolytically, for in this case it is mixed with a certain quantity of ozone. M. Villari, using two platinum electrodes, observed that the one dipped in ozonised oxygen was strongly electro-positive towards the one in chemically prepared oxygen. With palladium electrodes the phenomena is still more complicated, for, besides the ozone from the chemical decomposition of water, the palladium acting in a voltameter as positive electrode becomes coated with a dark red layer of oxide palladium. This oxide is soon dissolved in unacidulated water, and in a short time the metal takes its original properties; it behaves, further, as a strongly oxidising body. All the observations, including that of the time required for charging of the palladium with hydrogen, fully explain the differences obtained in the first direct comparative experiments with platinum and palladium batteries.

Profiting by the information now acquired, Prof Villari proceeded to a comparison of the batteries. He charged, in the proper way, a platinum and a palladium electrode with chemically prepared hydrogen, and half an hour after they gave, in the galvanometer, a constant deflection of 60° to 70°, the palladium appearing electro-negative. He also charged two similar electrodes with chemically prepared hydrogen, and they gave no current in the galvanometer. He then formed with these elements two gas-batteries,—the one with platinum, the other with palladium electrodes,—put them in opposing action, and closed the circuit with the galvanometer, which gave an initial deflection of 90°, sinking—with oscilliation—to 20° or 30°, later to 10° or 20°, and after some time to zero. The deflections indicated a superiority of the palladium battery. As soon as the galvanometric deflection had sunk only a few degrees, the author compared anew, by means of the galvanometer, the platinum and palladium in contact with hydrogen, and obtained a constant deflection of 60° to 70°, exactly as before this experiment; so that the negative electrodes had not, during this process, lost their action. He compared again the two platinum and palladium electrodes covered with oxygen, which at first, as stated, gave no deflection; and remarked that the latter gave a strong deflection of 50° to 60°, the palladium appearing as the attackable element of the combination.

This observation, repeatedly confirmed, is an indication (M. Villari says) of a secondary polarity appearing in the action of the battery with palladium electrodes, and which weakens its intensity till it is nearly equal to that of the platinum electrode.

A similar phenomenon occurs with the platinum, so that the platinum cannot be used as positive electrode of the palladium battery. Further, if as soon as the galvanometer connected with the opposing batteries has been deflected only a few degrees, we close one of the circuits for a few minutes with a short copper wire, it is found, on removal of this, that the action of the other battery preponderates, on account of the ordinary secondary actions which weaken more the battery closed with the short wire than that closed with the long galvanometric coil. Analogous observations and comparisons were made on batteries charged with electrolytic hydrogen and with chemically prepared oxygen; and similar results were had, though perhaps less marked than the above, corresponding to the less electro-chemical difference between platinum and hydrogenised palladium.

Lastly, Prof. Villari compared two batteries together, which were charged with hydrogen and oxygen developed electrolytically thirty to forty minutes on each of the platinum and palladium electrodes; and when both were connected with the galvanometer, they gave a first deflection of 90°, and a constant one of 50° to 60°,—in consequence, again, of the superior electromotive force of the palladium battery. It is to be noticed in this case, however, that the palladium—which acted as positive electrode—got covered with a dark red layer of oxide of palladium, which evidently increased the action of the battery: an action which, after consumption of the oxide, greatly diminishes, so that after some hours the intensities of the currents of both gas-batteries almost perfectly compensate each other.

These, then, are the actions which occur in a gas element with palladium electrodes. It is fully ascertained, from experiment, that such an element possesses a greater electromotive force than a Grove element, as the hydrogen brought in contact with the palladium (*i. e.* the negative electrode) is much more readily oxidisable than the hydrogen in contact with the platinum. This electromotive force increases yet more if the palladi m which is in contact with oxygen (*i. e.* the positive electrode) is oxidised, because it acts then as a very oxidisable body.

A NEW FORM OF ELECTRO-MAGNET.

A contributor to the *English Mechanic* thus describes an electro-magnet constructed upon a novel plan and possessing a power far greater than those of the ordinary type:

"First, I took a number of pieces of iron wire, 16 gauge and 12 in. long, and commencing half an inch from the end, I wound fine silk-covered wire (as used for the secondary in coils) for 2½ in. down, then gave two or three long turns, carrying the wire to within 3 in. of the other end, and wound that in the same manner as the first, and leaving long ends of the fine wire for subsequent attachment. The covered wire was then dipped in a spirit varnish and put aside to dry. When I had covered a number of these I bent them up into the form of a horse-shoe magnet, and put around them a number of pieces of similar wire, but uncovered, so that I had a horse-magnet much resembling the bundle of wire in the core of a 'coil.' The whole lot were then wound with eight coils of 16 guage covered wire in the usual manner, and all the ends of the fine wires soldered to the outside copper wire. The result quite surprised me, and no doubt will be of some use to those who do not mind a little trouble for the sake of a superior article."

The traffic receipts of the Direct Spanish Telegraph Company for the month of October amounted to 1,886.

Journal of the Telegraph.

This Journal is issued on the 1st and 15th of each month. Its circulation is over 8,000. It goes to every State, Territory and Province on the Continent. It has become a necessity, and is always welcomed as a friend. No better medium for advertising exists.

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JOURNAL OF THE TELEGRAPH,

Western Union Telegraph Company,

145 Broadway, New York.

NEW YORK, JANUARY 1, 1875.

MORE DISAPPOINTMENT.

The Direct United States Cable is as yet incomplete, while, for mysterious movements, sudden appearances and disappearances, the *Faraday* bids fair to rival that phantom ship of old, the *Flying Dutchman*. It will be remembered that, after a long disappearance, it was reported, on Nov. 25th, that she had recovered the cable which had been buoyed about 200 miles from the American coast, some weeks previous, and, owing to unfavorable weather, was again forced to abandon it. We now have reports from her up to Dec. 19th, and learn that during the long silence she had been engaged in taking up some forty miles of the shore cable which was laid last Spring, and had laid about ninety knots additional to the cable which had originally been buoyed off Newfoundland, and that *this* end is now buoyed. This is the latest and it is only thirteen days old.

It was not intended that the notice in reference to the new tariff books in the JOURNAL of Sept. 15th should have given the impression that they were to be generally distributed. The books should be ordered only by offices whose books of 1872 are unfit for use. The new issue is intended more particularly for sale to the public, and copies for customers will be furnished by the Tariff Bureau upon requisition through the Superintendents.

The attention of Superintendents and Managers is directed to the Executive Order which appears on the sixth page of this issue. It involves a change in the treatment of Government messages, and revokes Executive Orders Nos. 125 and 144, which heretofore have governed this class of business.

The quarterly dividend of two per cent. declared by the Western Union Company, is payable at the office of the Treasurer, on and after January 15th.

THE TROUBLES OF THE FRANKLIN COMPANY.

The joke which was lately perpetrated by the managers of the Atlantic and Pacific Company upon the stockholders of the Franklin Company turns out to be no joke after all. They have actually confirmed the lease which they had made to themselves by the same vote by which it was consummated, and the minority of the stockholders (a majority in number) have made good their threat of throwing the matter into the courts. Upon their petition the Supreme Court of Massachusetts have ordered all parties who may be interested to appear before them on the first Monday of February next, that they may then and there show cause why the prayer of the petitioners should not be granted. The wording of the petition is in plain Anglo-Saxon—with no mincing of terms. It is signed by George R. Williamson and seventy-four other stockholders of the Franklin Company, and in effect recites that the Atlantic and Pacific Telegraph Company has purchased a majority of the capital stock for the purpose of controlling the Franklin Company in its own interest; that by means of said control it has elected new officers, of which only one is a resident of Massachusetts, while there is reason to believe that all own stock or have a pecuniary interest in the Atlantic and Pacific Telegraph Company; that at least four of the Directors are not stockholders in the Franklin; that the Treasurer chosen is the Treasurer of the Atlantic and Pacific; that in pursuance of a plan to deprive the minority of the stockholders of the Franklin Company of their rights, and to greatly benefit the Atlantic and Pacific Company, a meeting was held on a call which is believed to be inadequate, at which authority was given to lease the Franklin Company to the Atlantic and Pacific Company for ninety-nine years at an annual rental of $25,000, which was a grossly inadequate rent, its value being at least $40,000; that an offer of $35,000 a year was made and was refused by the President, who also refused to call a meeting of the stockholders to consider the same, but thereafter made a lease to the Atlantic and Pacific Company at a grossly inadequate rental, and in fraud of the rights of more than one-third of the stockholders; that the President refuses to exhibit the lease to stockholders or to disclose its terms and conditions; that said lease was never legally voted by said Franklin Telegraph Company, and that if it was so voted, it was carried by means of the vote on the stock held by the said Atlantic and Pacific Telegraph Company, and that said Atlantic and Pacific Telegraph Company intend to defraud and are defrauding the stockholders of the Franklin Telegraph Company of their just rights in the premises; and praying that said lease may be vacated; and that the said Franklin Telegraph Company may be dissolved and a receiver of its property and assets appointed to sell the same, and after payments of its debts, divide the proceeds among its stockholders.

This is a very concise and interesting statement of facts apparent to the petitioners, and in the interest of business morality we hope that the transaction upon which the petition is founded will be thoroughly ventilated. The public will also be glad to learn how "lateral lines can generally be acquired without expense," which the Atlantic and Pacific Company profess to be able to do. We trust that the Company will, at the hearing, have an opportunity to "rise and explain."

THE SIGNS OF THE TIMES.

One of the indications of our advancing telegraphic civilization was very manifest in the recent organization of the American Electrical Association at Chicago. It was a step demanded by the times. But there is much to be done before such an organization can be widely and effectively influential. There is a process of education to be begun, not by publications alone, but by personal training and study. Many who have been content with a knowledge of the simpler elements in telegraphy must go to school. To understand and enjoy the proceedings of a scientific congress we must learn its idiom, and become accustomed to its language and methods of thought.

So we are glad to learn that it is proposed to form in New York, a class in telegraphic science, over which shall preside a competent teacher to direct its studies. It may be that by the time this reaches the eyes of our readers this class will be organized. Several names of earnest men have already been given as applicants for membership. The result of this initiatory step will undoubtedly lead to a more vigorous movement in the direction of an eastern organization similar to the one in Chicago. New York indeed, is, in some respects, the only proper centre for such an organization, although there may well be two, one for the east and another for the west. In New York naturally centre many facilities for scientific investigation as well as the men of science whose names are national. It is, therefore, with no desire to underrate the value of the Chicago movement, but rather otherwise, that we hail the signs of a similar movement in the east, and especially of that feature of it which aims at education as the first element of success.

The snow storm which occurred on Sunday, Dec. 20th, played sad havoc with the Police and Fire Alarm Lines of this city. Their wires were broken in every direction, and for three or four days the telegraph service of these departments was utterly demoralized. A more perfect wreck could hardly be imagined. The compound wire with which these lines were constructed was greatly inferior in strength to the ordinary galvanized iron wire used by the Western Union Company. An examination of the wires which laid upon the ground showed not a trace of copper, nothing but the steel, nearly eaten through by rust.

These are the lines erected by contract, for which the city was charged the enormous sum of $850,000, which is at the rate of $10,625 per mile of poles, and $1.360 per mile of wire.

ARGUMENT OF MR. G. P. LOWREY UPON THE POSTAL TELEGRAPH BILL.

(Continued from page 375, Vol. VII.)

The Committee on Appropriations of the House of Representatives resumed their sitting on May 29th, 1874, when Mr. Lowrey continued his argument on behalf of the Western Union Telegraph Company, as follows:

Mr. CHAIRMAN: At the close of the last meeting I was engaged in an effort to refute the assumption (which must be one of the necessary supports of this bill as a proper exercise of constitutional power) that the people of the United States have conferred upon Congress a power of control, necessarily exclusive, over the business of *communicating information.*

The fact that Congress is authorized to establish post-offices and post-roads is relied upon as authority for this proposition, and, in controverting it, I was led to remark that the post-office is not primarily an agency for communicating information, but an agency for carrying certain parcels known as mail matter. I fear that I was not able at that time to convey my precise meaning, and therefore I return briefly to this matter. Suppose a company should be organized for the purpose of employing messengers to run of errands, as in the City of New York, where we have what is called the Soldiers' Messenger Company. Suppose the business of the company was to send a messenger to any man's house who might want a message delivered; the messenger there to listen to what was said to him, and to go and report it to the intended receiver. Suppose that business should grow large, by reason of the messengers being faithful, trustworthy, intelligent and fleet-footed, so that the public came to trust them very much, and to send for them whenever a man wanted anything communicated. Suppose the business should become so large as to meet Mr. Hubbard's apparent idea of what constitutes an interest a national one, and that Congress should be asked to pass either for the Government to undertake that messenger business itself, or to set Mr. Hubbard up in it. Could such a bill be sustained on the ground that Congress has authority to establish post-offices and post-roads? Would it do to say that, because the post-office is a means by which information may be sent, and a messenger company is another, and because Congress has got the authority of establishing the one means exclusively, that it has therefore absolute control over all other means for that end which may be devised? I do not suppose that anybody would sustain such a claim.

Now, in regard to the exact functions of the post-office. It has neither sense of sight, or hearing, or touch, or faculty of comprehension of anything except a ponderable article which is brought to it. It does not know what that article contains. If the post-office official be bright or stupid, or the letter-carrier bright or stupid, it is all the same to the receiver and sender. The information which he gets is in no wise information for or from the post-office. All that the post-office does is to deliver the package, which may contain seed, or may contain information. If the sender should come to the post-office with information of a fire in Baltimore, and should say to the post-office, "I wish you to let Mr. Jones in New York know of this great fire in Baltimore," the post-office could not hear or comprehend him. It has no means of communicating his information as information, but it says to him, "If you want to convey this information to New York, wrap it up and seal it and we will take the package to New York for you." It is plain, therefore, that the post-office does not deal with information *as information;* and the argument that the Constitution authorizes Congress to deal with information *as such* has no basis. It authorizes the establishment of that peculiar known agency called the post-office; and the fact that it went no further shows that there are the limitations of congressional power upon this subject. The Government may control all such communications as are made in the form of sealed letters; as to all other communications between the people, they are reserved for such control as was in the people or the States when the Constitution was adopted.

Now I come to the method of communication by telegraph. It is merely an extension of the sense of hearing, and of the distance at which the human voice may be heard. The waving of flags by concerted signals is a means of communicating information. If a man goes to a person who, instead of tapping upon an electrical instrument, should be able to go into a mesmeric trance, and in that state be to impress another person in New York with the idea that a correspondent in Washington wishes him to buy five hundred shares of stock, that would be another mode of communicating information. Is that like the post-office? Is it to be supposed that, because Congress established the post-office, it must also assume charge of all people who go into mesmeric trances for this purpose? That is just the difference between the post-office and any other means of communicating information pure and simple; and it will be found, upon any accurate and proper analysis of the functions of the post-office and of other means of communicating information, that the attempt to sustain the control of the Government under the post-office clause is a perversion of all true methods of reasoning.

In leaving this discussion I repeat the query, do the Committee believe that the words "Congress shall have power to establish post-offices and post-roads," are convertible with the formula in which Mr. Hubbard's construction of these words must be stated, viz., "Congress may assume jurisdiction and control of all means, whether now existing or hereafter to be found out, *by which the people may communicate their thoughts.*" *If these phrases are convertible, then a constitutional amendment is requisite to put the post-office clause in form to authorize the passage of the present bill.*

The only other clause of the Constitution to which Mr. Hubbard refers is the commercial clause. Congress has the power to *establish* post-roads. It has the power to *regulate* commerce. The difference in the language indicates the natural distinction, which, in the judgment of the formers of the Constitution, exist between the two things. The one was something to be established. It was a thing in itself susceptible of one control. It can be established as a business. But commerce the Constitution found in existence. It is the intercourse and exchange of mankind. The Constitution has not created commerce. Governments have not created commerce. Governments are created for the purpose, among other things, of protecting commerce, which existed before governments were thought of. The Supreme Court has said that commerce is all intercourse; but is letter-writing intercourse in that sense? I think not. I do not believe that it will ever be found, on a proper construction, that telegraphing is commerce at all. Telegraphing is merely (to revert to the illustration I gave a moment ago) such communication as may take place between a man with a flag and telescope at Arlington Heights and a man with a flag and telescope here. That is not commerce. It is direct intellectual intercourse, and no people has granted, nor has any government ever assumed, the general control of such intercourse. That great numbers employ it is not only not a reason for, but a conclusive reason against, government interference with any means of intercourse except that one—the post-office—expressly passed over to congressional control. *Expressio unius est exclusio alterius.*

Mr. HUBBARD. There is an opinion of Attorney-General Hoar stating that telegraphic communication is commerce.

Mr. LOWREY. There is an opinion of one of the Attorney-Generals, in which he says that it assimilates to commerce, and that Congress has at various times passed acts concerning it. The acts he referred to were those authorizing the landing of cables on the coast, but none of them assumed to influence the use of those lines, &c. That was all that was said. After this opinion has been read, if it says anything more than I now state, I think the Committee will doubt it. The question as it now arises was not presented to Judge Hoar. There is a great deal of ignorance about the matter of telegraphing. The suddenness of the invention, the mystery of its operation to the people who have no time to investigate it, has all left, even on intelligent minds, a curiously wrong idea about it. Mr. Starkweather referred the other day to a class of cases brought against telegraph companies. I have no doubt he knows that when people come to consult him in regard to suits against a telegraph company, they have the vaguest idea as to what the telegraph company has undertaken to do for them; and they think it has undertaken to do more than any contractor has ever undertaken to do. The telegrapher has no means of telling whether he sends his telegraph correctly. He may send the same message a thousand times, and he cannot tell whether he has sent it correctly, except by the process of its being repeated back. It is as if I were to repeat here a certain formula of words and you should try to take it all down. You could not be sure that you had done so until after a certain proof-reading. That is done in telegraphing, when specially paid for, at a rate which merely covers the cost of the repetition; and it is that alone which gives certainty. And yet people complain of the telegraph because it does not do its writing with an accuracy which no man ever does when he writes a letter. I presume that no gentleman present writes a letter that he does not read over to see if he has not omitted a word. The telegraph operator cannot do that. He hears sounds from his instrument and writes the interpretation of it as it goes along, leaving no record. Yet it is supposed that the telegrapher must write more accurately than a person who writes leisurely at his table.

I was proceeding to say that telegraphing is not commerce. But suppose it is such a servant to commerce that it is to be called commerce itself, (and I do not know that I have any objection to that,) still what may Congress do in regard to commerce? Establish it? No; regulate it. What is the creation of a company to build a railroad? It is the establishing of a railroad. It is not the regulating of a railroad. The distinction between establishing and regulating is this: That, as to commerce, Congress has the right to regulate that which it finds in existence—that is to say, to protect it. The motive of this clause in the Constitution was that there should cease to be those onerous and annoying exactions at State lines which at the time existed. It was not that Congress should have power, at any time, to set anybody up in business in commerce. Nor has that power, within my knowledge, ever yet been asserted. But suppose that this was not so; Mr. Hubbard's bill does not come within the power to regulate commerce because it is commerce among the several

States, with Indian tribes and with foreign nations only, which Congress is to regulate. Here is a bill to authorize the telegraph business all over the country and within each State; as much between New York and Rochester as between New York and Boston. The justification of this interference within a State is that the business of telegraphing has become so large and the communications by telegraph have become so numerous. That claim, being analyzed, turns out to be this: It is supposed that because this means, which is simply the means for the rapid and accurate communication of thought between people, has come into extensive use the Government has a duty concerning it. This Government was organized for no such purpose. The people of the United States need no governmental aid in their intellectual intercourse; nor, when the subject is understood, will they tolerate it otherwise than in the express limited method fixed by the Constitution.

Any claim to control the telegraph, irrespective of State lines, as a means of communicating information, applies with equal force to the printing of newspapers in the State, the printing of books, and the circulation of books and papers, and every method by which men are able to share their knowledge and thoughts with others at a distance. In fact Mr. Hubbard's whole scheme, and, I apprehend, the scheme of the Postmaster-General, is based on misconception of the powers of this Government—apparent indifference to the purposes for which it was created—and a blind heedlessness of the limitations of power inherent in its nature.

I now approach a branch of the subject which is a little more difficult. The one which I have left is, to my mind, comparatively easy. The difficulty in the other consists in the fact that we begin now to deal with figures, and, as it was said of the Christian religion in early times, that it contained "depths where an elephant might swim, and shallows where a mouse might ford," so whoever deals with estimated figures and comparative statistics will find that statistics are easy or difficult of comprehension as the expert manipulator chooses to make them. On our part, however, we propose not to deal with estimates nor guesses, as Mr. Hubbard, on his part, has necessarily to do, since he has a problematical case to establish.

I shall deal with actual facts of experience, and shall hope to escape entanglement with Mr. Hubbard's artificial web of conjectures and hypothetical calculations upon the future, by confining myself to the established experience of actual history. I shall ask the Committee to accompany me in a little excursion through the history of the assumption of the English telegraph by the English Government. And here I may remark, without at all deprecating the talent and industry which Mr. Hubbard has brought to the advocacy of his project, that I have been amazed, and not a little amused, on reading the history of this business in England, to discover that that which I supposed to be original here, and perhaps a creditable American notion in regard to the telegraph, is entirely borrowed from English blue-books. Mr. Hubbard's theories are but the faint re-echo of this English business. On going through the blue-book, I find our old story, with all the variations and inflections. When Mr. Scudamore goes up, and hopes and estimates boldly, Mr. Hubbard goes up; and when Mr. Scudamore doubts and goes down, Mr. Hubbard goes down.

Mr. Scudamore is to be credited with the assumption of the telegraph by the English Government. He is an English gentleman, of that thorough training which English men of business receive. He has been connected with the post-office department since 1840, and has risen to high rank in it, that of Second Secretary to the post-office. He knows the post-office thoroughly. He began about 1860 to study the subject of uniting the post-office and the telegraph in England. It was very interesting to him. He went abroad and examined all the systems of the continent. He sent expert persons abroad to examine them. He spent five or six years in a careful study of the subject—a study such as is very seldom here to any question of administration. Of course, he had first to deal with Parliament and with the committees of Parliament. He entered upon this gay and joyous business of making estimates, (perhaps, after all, the lightest occupation one can undertake who has no pecuniary responsibllity for results,) with a spirit as hopeful and prophetic as Mr. Hubbard now exhibits. He stated before the parliamentary committee his first estimate, after years of study and examination, of the cost of the telegraph as £2,400,000. That was all that was to be paid to put the Government in possession of all the means of telegraphing then existing in the United Kingdom, and to give it all that it wanted to carry on the business. Soon he thought it would take £3,000,000. That raised some little criticism. Then it became £3,600,000. That excited a good deal of remark and a good deal of critical discussion. Then he said he could do it for less than £6,000,0000.

By that time he had got the Government committed to his plan, and Mr. Gladstone was attending hearings before the Committee. Mr. Scudamore was fairly launched. The responsibility was off his shoulders. When the bill was passed it gave him £7,000,000 for the purpose. The next year it took, in fact, £8,000,000. The next year £9,000,000. And up to the present time it has cost the English Government about £9,250,000 to pay for what, in the beginning, Mr. Scudamore said would cost £2,400,000. And now I think it will enlighten the subject a little if I read briefly from this blue book. It will show us the termination of the road which Mr. Hubbard invites us to travel.

The CHAIRMAN. What is it?

Mr. LOWREY. Mr. Hubbard invites the Government to undertake the business of telegraphing with him; that is to say, he puts forward the post-office to contract with third persons, both for receiving and sending telegraph messages; he to perform a part of the service for the larger share of the pay, but without responsibility to the customer or the Government. Mr. Hubbard estimates that the existing lines, or equivalent new facilities, can be got for a certain amount. Mr. Scudamore estimated that he could get the existing lines for a certain amount. He was no amateur. He was a business man, acting under official responsibility, and with a business reputation and political standing to lose. Now, I am going to show you how fatally misleading were all the calculations of this astute, practical and earnest gentleman, when he undertook a business which he did not understand.

I read from the special report of the select committee on the electric telegraph bill, together with the minutes of evidence ordered to be printed by the House of Commons on the 16th July, 1868:

(*To be Continued.*)

ELECTRIC LIGHTS FOR LIGHTHOUSES.

It is stated that the two lighthouses at the Lizard promontory, on the southern coast of England, at the entrance of the British Channel, are about to be fitted with the requisite apparatus for exhibiting the electric light. In experiments recently made near Paris, with an electric light specially adapted for illuminating distant objects, it was found that distance up to ten miles could be clearly brought out, and by means of telescopes every point in the cone of light could be reconnoitered.

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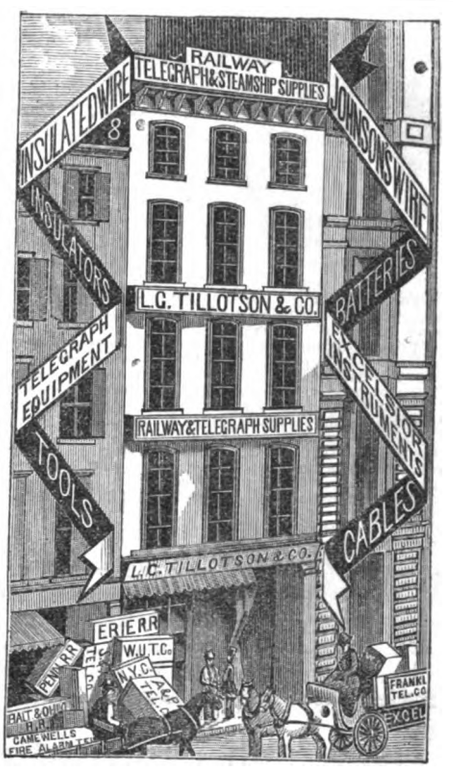

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JOURNAL OF THE TELEGRAPH.

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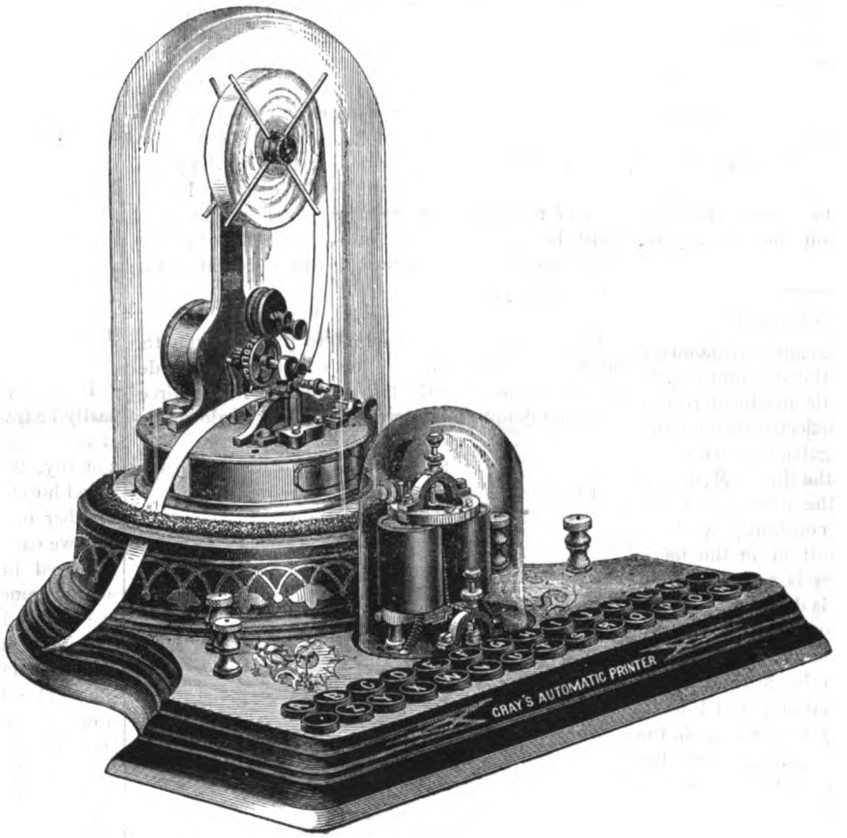
THE GOLD AND STOCK TELEGRAPH COMPANY'S PRIVATE LINE SYSTEM.

GRAY'S PRINTING INSTRUMENT.

Among the numerous modern applications of the Electric Telegraph which have attained such an extraordinary growth and development within the past few years, one of the most important consists in the establishment of private lines connecting two or more places of business; the offices of merchants and manufacturers with their residences, warehouses and factories; and to fulfill other requirements of this nature, which readily suggest themselves. Probably the first line of this description built in this country was constructed for Col. R. M. Hoe, the celebrated inventor of the cylinder printing press, who built a line in 1849 from his office in Gold street to his manufactory in Sheriff street, in this city, a distance of about two miles, and equipped it with the ordinary Morse registers. The necessity of employing a special skilled operator was, for many years, a great drawback to the general introduction of private lines, and even after alphabetical dial instruments became available, but comparatively few such lines were erected. The business—what there was of it—fell into the hands of irresponsible parties, who, when they had secured a contract for a line, erected one of the cheapest and most inferior character, which answered the purpose if it held together long enough to enable the builder to get his money for it and depart. There were, of course, some honorable exceptions to this rule, but it was not until within a comparatively recent period that anything worthy of the name of a complete system was established.



In 1871 the Gold and Stock Telegraph Company of this city, having previously established an extensive system of lines and instruments for reporting the quotations of the gold and stock exchanges, decided to add a regular private-line department to their rapidly increasing business. The Company accordingly made arrangements to purchase or control all the most valuable patents for printing instruments adapted to this purpose, other than those already owned by it. They then proceeded to construct pole lines of the most substantial, durable and costly character through the principal business portions not only of New York, but the adjoining cities and suburbs of Long Island and New Jersey, the latter being brought into connection by a large number of submarine cables. The plan of operations adopted by this Company was that of erecting a sufficient number of lines to meet the probable requirements of the business, which could then be made available to connect any required points within the range of the Company's field of operations. By this means they were enabled to furnish at short notice, to parties desiring it, a complete telegraph line, equipped with type-printing instruments, batteries and other necessary requirements, and by means of a trained corps of skillful and efficient employés to assume the entire charge of it for a very moderate annual rental. That this policy was an eminently sagacious one has been sufficiently attested by the subsequent rapid development of the system.

The necessity of providing for use upon this class of lines a printing telegraph instrument of easy and simple manipulation, requiring no scientific or mechanical knowledge, nor previous experience on the part of the person operating it, was early recognized by the officers of the Company, and has led them to extend the most liberal encouragement to all inventions and improvements in that direction. The result of this wise policy has been that a number of instruments and methods of great value have been developed and perfected, and afterwards, through the agency of the Company, extensively introduced into practical use.

One of the best of these instruments for private lines, and one which is now more extensively used than any other throughout the United States, is Gray's Automatic Printer, of which we present a fine illustration. The limited space at our command will not permit of our giving in the present article, a description of another instrument of this kind, which is also being largely introduced, known as Edison's Engine Printer, but we shall probably be able to do so in a future number.

As will be seen by reference to the illustration, the mechanism of Gray's apparatus is mounted upon a handsomely ornamented iron base, the working parts being protected from dust by glass shades. The key-board extends across the front of the base, and consists of twenty-eight keys, upon which are engraved the different letters of the alphabet, with the necessary punctuation points, etc. The blank key at the extreme right is used to start the instrument. Beneath the small glass shade at the rear of the key-board is an upright polarized relay, behind and above which is situated the type-wheel and printing apparatus.

The communications are printed as received upon a continuous strip of paper which is fed from the roll above. The type-wheel is made to revolve by means of a double acting pallet escapement, attached to an armature which vibrates between the poles of two local magnets within the hollow base of the instrument. At the back of the instrument, directly in the rear of the type wheel, is a cylindrical brass case containing what is called the "sunflower." This is a flat annular disc of platinum, divided radially into equal segments corresponding in number to the transmitting keys, each of these segments being connected to its corresponding key by an insulated wire. A circuit-closing arm, rigidly attached to the type-wheel shaft, travels over the divided disc as the shaft revolves, and places the latter in electrical connection successively with each segment. The same circuit (which is that of the main line) is conducted through the coils of the polarized relay, and this, by means of a local circuit, controls the escapement magnets above alluded to.

The general principle upon which the instrument acts may now be understood without difficulty, although the details would require special drawings to render their description sufficiently clear. Upon breaking the main circuit, by depressing the extreme right-hand key, the relay moves and the local magnets

release the escapement, which in turn allows the type-wheel to move forward a step, carrying with it the moving arm upon the sunflower. By means of a pole-changer attached to one instrument only in each circuit, the direction of the line current is reversed for each letter passed over, and thus the polarized relay and escapement magnets continue to vibrate automatically until the sender depresses some other key. The depression of this key breaks the circuit leading to the corresponding segment of the sunflower, and when the traveling arm reaches this segment the main circuit is interrupted, the escapement cannot act, and the type-wheels of both instruments come to a stand. The letter or character upon the type-wheel corresponding to the key which has been depressed upon the sending instrument being thus brought opposite the paper strip, the impression is effected by a magnet in the local circuit, which is instantly brought into action upon the cessation of the vibrations of the relay armature.

Thus it will be seen that any person who can read and spell can transmit communications upon this instrument merely by fingering the appropriate keys, and that these may be automatically recorded, even in the absence of an attendant, at one or more distant points.

This instrument is a comparatively recent invention, having been first introduced so lately as the autumn of 1871, since which time nearly a thousand have been manufactured and set in operation. The ordinary speed of transmission attained by persons who have become familiar with the positions of the letters upon the key-board is usually from 14 to 16 words per minute. The apparatus is very simple and in practice is not found to be liable to disarrangement. It can be worked on lines of any required length.

THE SINE GALVANOMETER.

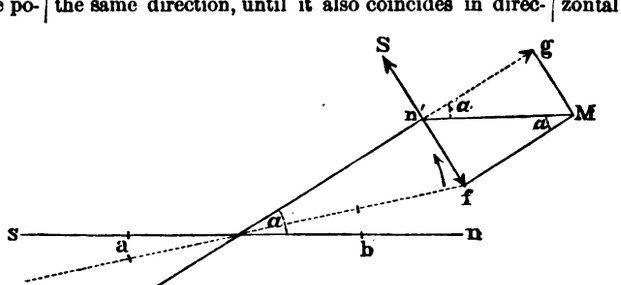
The principle upon which the sine galvanometer is constructed is illustrated in the diagram Fig. 1. The line $s\ n$ represents a magnetic needle at rest in the meridian. If the needle is deflected through the angle α, by the influence of a galvanic current $a\ b$ flowing in the same plane, then the line n' M, drawn parallel to $s\ n$, will represent the direction of the earth's magnetic force, which constantly tends to bring the needle back to its position in the meridian. The intensity of this force is represented by the length of the line n' M, and is denoted by M.

In order to ascertain what portion of this force acts upon the needle, we may resolve n' M into two forces, viz.: $n'\ f$ acting in a direction at right angles to the needle, and $n'\ g$ in a direction parallel to it. The latter, however, is entirely exerted upon the fixed turning point. Therefore $n'\ f$, represents the actual force of that portion of the earth's magnetism which tends to bring the needle back to the meridian $s\ n$. Therefore we have

$$n'\ f = n'\ \text{M. sin}\ \alpha = \text{M. sin}\ \alpha.$$

Thus the force of the earth's magnetism, which tends to bring a deflected needle back to its state of rest in the meridian, is always equal to M. sin α, in which M remains constant, so long as the needle remains at the same point on the earth's surface, and retains its original magnetism.

The coil of the sine galvanometer must first be placed parallel with the magnetic meridian. When the needle is deflected by the passage of the current through the coil, the latter is turned after the needle until it coincides with its new direction. To illustrate this, let $s\ n$, Fig. 1 represent the needle at rest in the meridian, and $a\ b$ the galvanometer coil parallel thereto. Now suppose that the passage of the current deflects the needle and causes it to assume the position indicated by the dotted line, and that the coil $a\ b$ is then turned in the same direction, until it also coincides in direction with the dotted line; the needle will be deflected still further in the direction of the arrow, because the tendency of the current is always to bring the needle into a position at right angles to its own course; but this is constantly opposed by the directive force of the earth's magnetism, tending to carry it back to the meridian. By continuing the movement of the coil in this direction, a point is at length reached at which the coil and the needle are again parallel, which is represented by the line $s'\ n'$. The influence of the galvanic current upon the needle is still exerted, as before, in a direction at right angles to the conducting wire, denoted by the line n' S, while that portion of the earth's directive force which acts upon the needle, is represented by $n'\ f$. The needle being at rest under the combined influence of these two forces, it follows that the forces must be equal to each other. The force n' S is, therefore, exactly equal to $n'\ f$. But $n'\ f$ — M. sin α; consequently,



Fignre 1.

$$n'\ \text{S or S} = \text{M. sin}\ \alpha.$$

If we allow another current to pass through the same coil, and again turn the coil towards the deflected needle until the two again coincide in direction, and denote this current by S', the angle of deflection by α',

$$\text{S}^1 = \text{M. sin}\ \alpha';$$

and for both currents,

$$\text{S} : \text{S}' = \sin\alpha : \sin\alpha',$$

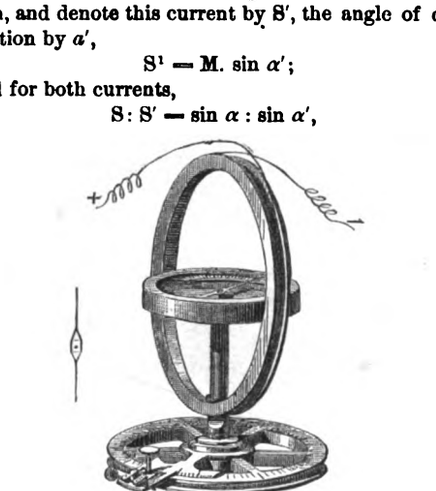


Figure 2.

That is to say, the magnetic forces of two galvanic currents are to each other as the sines of the angles of deflection of the needle, in cases when the galvanometer coil has been turned after the needle, until the direction of the two is coincident.

The sine galvanometer is founded upon these laws. Its essential parts will be easily understood by reference to Fig. 2. In the center of the divided horizontal ring is placed the magnetic needle, while the vertical ring contains the conducting wire. The whole is so arranged as to be capable of being turned around its vertical axis, and the angle through which it is turned may be read off from the graduated horizontal circle below.

When using the instrument, the index on the lower graduated circle is placed at zero, and then the coil is turned until it stands in magnetic meridian, so that the needle points to the zero of the upper graduated circle. If we now allow the current which is to be tested, to pass through the coil, the needle is deflected. The vertical ring, which contains the conducting wire, is now turned in the direction of the deviation of the needle, until the two are brought into the same vertical plane, and the needle again points to zero, as the upper divided circle has kept company with the coil in turning. The deflection of the needle is then read off from the lower circle, and the sine of the angle of deflection is the measure of the strength of the current.

When the sine galvanometer is used for measuring weak currents, the convolutions of the conducting wire should be as numerous and as close as possible to the needle.

As the sine galvanometer, when properly arranged, is more expensive and not so convenient for general use as the more simple tangent galvanometer, it is but little used except for scientific experiments, especially in cases where the currents which are to be measured are not strong enough to act upon the needle of the tangent galvanometer with sufficient power.

The Multiplier Arranged as a Sine Galvanometer.

It is obvious that the ordinary multiplier may easily be transformed into a sine galvanometer, when it is so arranged that the coils may be turned horizontally, independently of the needle, and a graduated horizontal circle so arranged as to indicate the number of degrees traversed upon a fixed index. But we can, with equal convenience, when there is no fixed index or graduated circle, indicate the angle through which the coil is turned by means of the multiplier, if, after the current has been made to pass through the coil, we turn the latter after the deflected needle, until they coincide and the multiplier wire becomes parallel to the needle. If we now interrupt the current, the needle returns to its state of rest, and describes exactly the angle which the coil has traversed in its removal from its original position in the magnetic meridian.

If it is not practicable to turn the coil itself, we may still use the multiplier as a sine galvanometer, by placing it upon a horizontal disc, capable of being turned around a vertical axis, and provided with a graduated scale. This, of course, is managed in the same way as a sine galvanometer.

In using this instrument, care should be taken to ascertain that after a current has been measured that the needle still retains its original magnetism. This may be very easily done by observing whether the needle, after the current has been broken, returns completely to its former position of rest, the zero point of the scale.

Siemens & Halske's sine tangent galvanometer

(Fig. 3), is an instrument which may be used both as a sine and a tangent galvanometer. The annular horizontal plate P, upon which the wire ring R and the needle-box M are fixed, may be turned by two insulated handles *u* in the plate P, of which only one is visible in the drawing.

Upon the circle Q is a graduated scale T and upon the movable ring P is an index mark *i*. By means of this graduated scale T the angles are read off in the manner heretofore described when the galvanometer is to be used by the sine method. Within the needle-box is also another graduated scale T, by means of which the angles are read off, when the current is to be measured by the tangent of the angle of deflection.

The coil R consists of 16 convolutions of wire $\frac{1}{19}$th inch thick, which proceed from screw k^{I} to screw k^{II}, and of 1050 convolutions of thin wire ($\frac{1}{100}$th of an inch), which pass from screw k^{III} to k^{IV}. The thicker coil has a resistance of less than 0.1 Siemens units (which will be hereafter explained), while the resistance of the thinner coil is about 150 Siemens units.

When screws k^{I} and k^{II} are connected with the poles of a battery, then the thick wire coil alone is connected; but when k^{III} (not visible in the drawing) and k^{IV} are connected with the poles of a battery the thin wire coil only is in circuit. By pulling out the knob *u* two stops are caused to project in the needle-box M, so that the swing of the needle is confined between narrower limits.

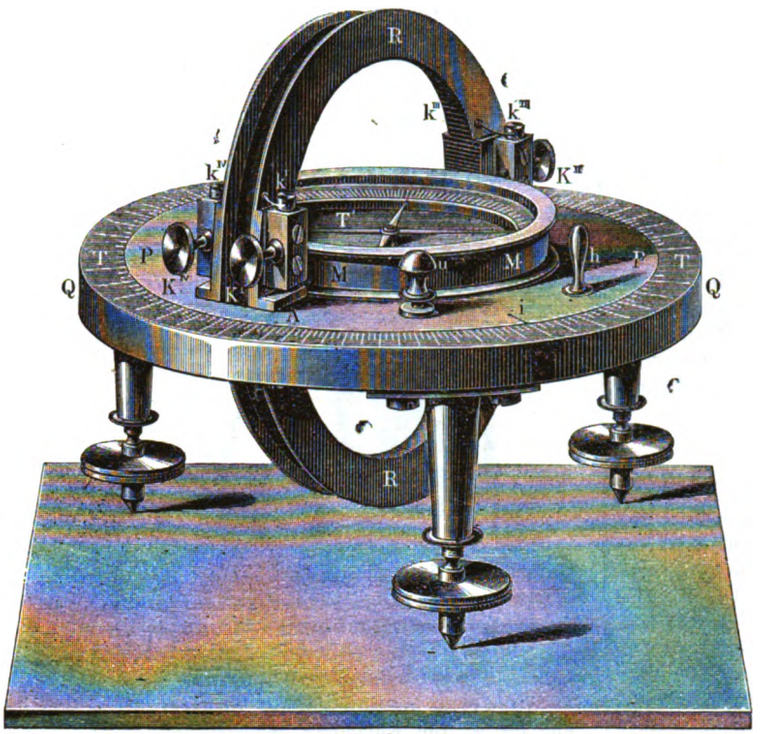


Figure 3.

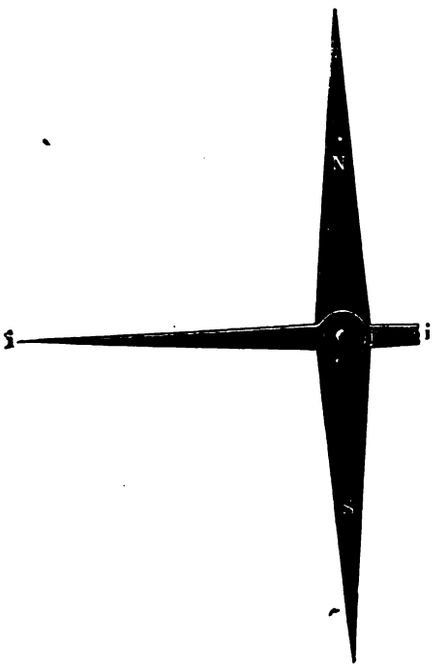


Figure 4.

Fig. 4 represents the sine needle, and is of full size. The pointer *i i* is of aluminium.

Fig. 5 represents the tangent needle, of full size. The pointer *i i* is also made of aluminium.

When the currents are of such force that it is impossible to read off the angles with accuracy, a portion only of the current is allowed to pass through the instrument. This is accomplished by inserting an additional wire between the corresponding screws of the instrument, the resistance of the wire being in a known proportion to that of the coil of the instrument. The theory of resistances and branch currents will be considered hereafter, but for the sake of completeness we will refer also to its use with the sine-tangent galvanometer for the benefit of such persons as are already familiar with the principle.

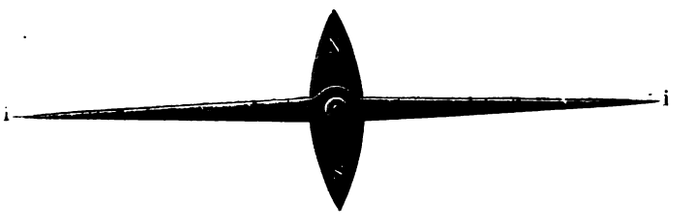


Figure 5.

Referring to Fig. 6, suppose *w* to be this branch wire, while W represents the resistance of the instrument, E the battery, and S′ the current passing through the galvanometer with the branch circuit

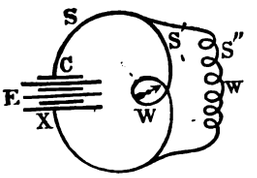


Figure 6.

open, S″ the current through the branch circuit only; then, if S represents the entire strength of the current of the battery in the portions of the circuit outside the galvanometer, we have:

$$S = S' + S''$$

$$S' : S'' = w : W$$

Hence, $$S = \frac{W + w}{w} S'.$$

If we substitute in succession for *w* the values $\frac{1}{9}$ W, $\frac{1}{4}$ W and W, we obtain:

$$S = 10\ S'$$
$$S = 5\ S'$$
$$S = 2\ S'$$

A branch wire, thus arranged to convey a portion of the current around the instrument, is termed a *shunt*. Fig. 7 represents a box or case containing three such shunts or branch wires, the respective resistances of these wires being in the proportion above stated. The binding screw marked 0 forms the common terminal of the three shunts, while the resistances of $\frac{1}{9}$ W, $\frac{1}{4}$ W and W, proceeding therefrom, terminate respectively in the screws

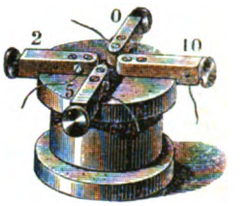


Figure 7.

marked 10, 5 and 2, as illustrated in Fig. 8. If, therefore, we connect 0 with one of the binding screws of the sine-tangent galvanometer (Fig. 3), and either 10, 5 or 2 with the other binding screw, the branch circuit or shunt thus connected will divert a portion of the current, and the remainder which still passes through the instrument, will be only $\frac{1}{10}$, $\frac{1}{5}$ or $\frac{1}{2}$ the original amount, as the case may be; therefore, in order to obtain the true value of the strength of the current, we should multiply sine or tangent of the observed angle respectively by 10, 5, or 2. In this manner, by the aid of shunts, it is quite possible to make use of very sensitive instruments to measure powerful currents. The combined sine-tangent galvanometer is very well adapted for telegraphic purposes, all the measurements which were required in laying the Red Sea cable having been made with one of these instruments.

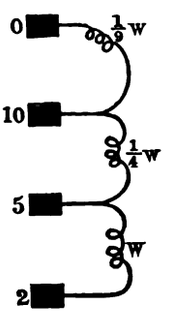


Figure 8.

Precautions Necessary in Using Galvanometers.

Great care should be taken, when using any galvanometer, not to allow too powerful currents to pass around the needle, as such currents are liable either to change the magnetic intensity of the needle or to reverse its polarity altogether. Hence, in order to avoid the injurious influences upon the magnetism of the needle even of feeble currents, the currents

should not be allowed to act upon a galvanometer for a longer time than is necessary.

When using the tangent galvanometer, it must be remembered that the trigonometrical tangents of the angles 0° to 45° of a circle whose radius is 1, increase from 0 to 1, but that, on the contrary, for angles of 45° to 90° the tangents increase from 1 to ∞ (infinity). It follows, therefore, that at large angles, a very considerable change in the strength of the currents will produce but a slight change in the angle of deflection, and that, even in a very accurately constructed instrument, an increase in the angle of deflection is hardly perceptible; or rather is quite imperceptible, although the current-strength may have been considerably increased.

The case is similar with the sine-galvanometer. The difference in the sines between 1° and 10° is very much larger than the difference in the sines between 81° and 90°. For this reason the sine galvanometer is much more accurate in the measurement of large angles than smaller ones; the reverse being the case, as we have seen, with the tangent galvanometer.

THE VOLTAMETER.

Faraday has shown that the chemical action of a galvanic circuit is equivalent to its magnetic action, and that the quantity of water decomposed in a certain time by a current, or, what is the same thing, the volume of inflammable gas evolved during that time is in proportion to the strength of the current.

If, therefore, we take an apparatus for decomposing water, which is provided with a graduated glass tube for the purpose of retaining and measuring the inflammable gas formed by the decomposition of the water, we have an instrument termed the Voltameter, which may be employed for the purpose of comparing the strengths of different currents with each other.

Figures 9 and 10 show the construction of the Voltameter.

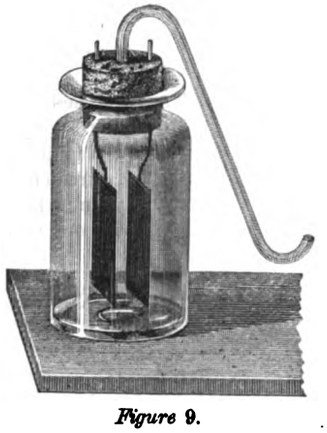


Figure 9.

The glass vessel is filled with dilute sulphuric acid, or preferably with pure sulphuric acid of 1.3 specific gravity. Through glass tubes inserted in the leaden plug which closes the vessel at the top pass two insulated copper wires, hermetically sealed, into the vessel, where they are soldered to two thin platinum plates, which stand opposite to each other and as near together as possible. The copper wires in the inside of the vessel are protected from the action of the acid by a coating of varnish. If we connect the ends of the copper wires protruding from the leaden plug with the poles of a battery, then the current passes from one platinum plate to the other, through the acidulated water, which is thereby decomposed, forming inflammable gas. The latter ascends and escapes through the bent tube. In order to measure it we confine it in a glass tube, divided in cubic centimeters, as represented in Fig. 11. If we wish to measure this with accuracy, and have the inflammable gas perfectly pure, the compound gas that is separated from the water should be made to pass through sulphuric acid, in order to remove any water which it might contain.

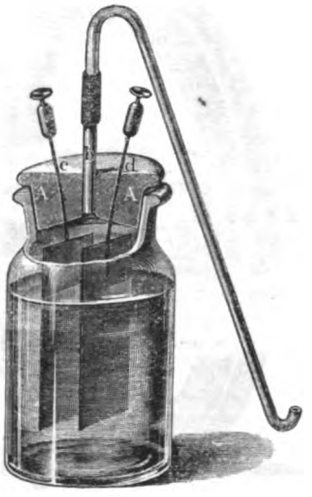


Figure 10.

Nevertheless, it must not be forgotten that the insertion of a voltameter into the circuit of a battery, on account of the great resistance which it opposes to the passing of the electricity, materially reduces the strength of the galvanic current.

Reduction of the Volume of Gas.

The use of the voltameter requires an exact measurement of the volume of inflammable gas formed by the current in a given time. The volume of a confined gas, however, according to Mariotte's laws, depends on the pressure brought to bear on it, the volume decreasing in the same proportion that the outside pressure increases. Besides this, the temperature has an important influence upon the volume of a confined gas. With respect to the latter circumstance the careful investigations of physicists have shown that all gases are subject to the same amount of expansion for like changes of temperature, and that for each degree over or below 0° Centigrade, the change in volume of the gases amounts to about $\frac{1}{273}$ of their volume at 0°, or 32° Fahrenheit.

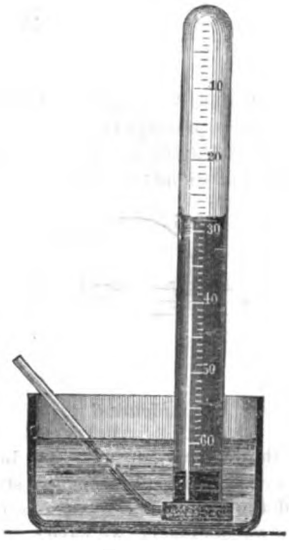


Figure 11.

In measuring a certain volume of gas, it should therefore always be stated at what temperature and under what pressure the measurement has been made, and when several different volumes are to be compared the measurements ought either to be made at the same temperature and under the same pressure, or, as this often is not practicable, the results must be reduced by calculation, so as to render them comparable with each other.

It has therefore been agreed upon, in making these reductions, to adopt the temperature 0° C. and the barometrical pressure of 760 millimetres (30 inches) of mercury. If, therefore, we have measured the volume of inflammable gas originating from the decomposition of water at a temperature of $t°$ and a pressure of b millimetres, then we must by calculation find what the volume would have been at a temperature of 0° C. and barometrical pressure of 760 millimetres.

The quantities of inflammable gas obtained under the same conditions, the temperature and pressure being the same, by means of galvanic currents in the same length of time, are in proportion to the strengths of currents themselves.

In order to make the necessary corrections, we must first ascertain what the volume of gas would have been, measured at the temperature of $t°$ and a pressure of b mm., in case the pressure had been 760 mm. and the temperature 0°. Let us call the volume of gas measured at $t°$, V, and the volume of gas at 0° v_0, then for each degree of temperature the gas expands about $\frac{1}{273}$d part of the volume which it occupies at 0°; hence, for $t°$ the gas expands about $\frac{t}{273}$d part of its original volume at 0°; therefore volume v_0 for $t°$ temperature increase expands about $\frac{t}{273} \times v_0 = \frac{tv^0}{273}$; the true volume at t:

$$V = v_0 + \frac{tv_0}{273} = \frac{273v_0 + tv_0}{273} = \frac{v_0(273+t)}{273},$$

and therefore the volume at

$$0° \text{ or } v_0 = \frac{273V}{273+t}.$$

From the measured volume of gas V at b mm., we have, under the same pressure, volume $v°$ at the temperature °. If, however, instead of b mm., the pressure were, for instance, 760 millemetres, then, according to Mariotte's laws, if we denote volume corresponding to 760 millimetres pressure by x, we have

$$x : v_0 = b : 760,$$

and from this

$$x = v°, \frac{b}{760}$$

If we substitute the previously known value of v_0 in this equation, then we have

$$x = \frac{273 \cdot V \cdot b}{(273+t)760}$$

In order to make this formula more clear by a numerical illustration, let us suppose that a certain current has developed in the voltameter 30.8 cubic centimetres inflammable gas per minute, at a temperature 15° C., and a pressure of 740 millimeters. To reduce this volume to 0° C., and 760 millimeters, we have to substitute in the preceding formula

$$V = 30.8,\ b = 740,\ t = 15,$$

from which we have

$$x = \frac{273 \cdot 30{,}8 \cdot 740}{(273+15)760} = 28.43 \text{ cubic centimeters},$$

That is to say, the current would have developed 28.43 cubic centimeter inflammable gas in one minute, at a temperature of 0°, and a pressure of 760 millimeters.

The Unit of Measurement.

Measurement is simply the comparison of an unknown quantity with a known quantity of the same kind. In order, therefore, to measure the quantity of a galvanic current it becomes an absolute necessity to adopt a known current, whose intensity then forms a unit of comparison by which to measure other strengths of current.

Among the several methods proposed for measuring the strength of currents, the unit employed by Jacobi deserves the preference, on account of its simplicity and clearness.

According to Jacobi, the unit strength of current is that which in one minute evolves 1 cubic centimetre inflammable gas at a temperature of 0° C., and a pressure of 760 millimeters; consequently any current which gives in one minute a volume of a cubic centimeters inflammable gas its strength is a, because the quantity of water which the latter has decomposed is always proportional to the volume of the inflammable gas evolved.

Measurement of the Current Strength by Means of the Voltameter.

In order to measure the strength of a galvanic current by means of a voltameter, it is only necessary to insert the latter into the circuit and mark the time by the watch. When we have a sufficient quantity of gas, then we interrupt the current, note the time during which the circuit has been closed, and measure the volume of gas obtained. If the temperature was not 0° and the pressure not 760 millimeters, then the necessary corrections of the volume of gas should be made.

We easily find from the reduced volume, by dividing it by the number of minutes which have elapsed, how many cubic centimeters inflammable gas at 0° C, and 760 millimeters pressure the current has given per minute, and this number at the same time denotes that of the intensity of the current itself, that is to say, it indicates how many times stronger this current is than one which gives one cubic centimeter of gas of the same density per minute. Accordingly it follows that the strength of such a current, which gives in one minute 30.8 cubic centimeter of gas at 15° C, and 740 millimeters pressure, becomes, after reduction, 28.43.

Although the manipulation of the voltameter is apparently very easy, it is nevertheless not always available to measure the strength of currents, because weak currents decompose the water so slowly, that it would require altogether too much time to obtain a measurable volume of gas, and the current during such a length of time would perceptibly change its strength. On the other hand, the liquid in the voltameter opposes considerable resistance to the passage of the electricity and weakens the current. For this reason the quantity of gas obtained indicates the force of the current which has actually passed through the voltameter, and would have not the strength which the current from the same source possessed, if it had not been made to pass through the voltameter.

Measurement of the Strength of Current by Means of the Tangent or Sine Galvanometer.

The resistance which the coil of the tangent galvanometer opposes to the passage of the current is so small in comparison to that of the voltameter that it may almost always be included in the circuit without perceptibly diminishing the current. On the other hand, in these instruments, the indications of the needle depend upon the diameter of the coil, and therefore the same strengths of current on different instruments give different angles of deflection. The same instrument, when the strength of current is the same, will also give unequal deflections of the needle at different places upon the earth's surface, because the intensity of the magnetic power of the earth, (the horizontal component of which always tends to carry the needle back to the magnetic meridian), varies upon different parts of the globe. Nevertheless, it is easy, by carefully comparing the indications of the tangent galvanometer with a voltameter, to ascertain their relative value.

In order to compare the indications of the tangent galvanometer with the results of the voltameter, we must insert both a galvanometer and a voltameter in the circuit of a battery of several elements, and observe both the angle of deflection of the needle and the number of cubic centimeters of inflammable gas which the voltameter produces in one minute. Suppose this current has a strength of S, and produces in one minute a cubic centimeters of gas (at 0° C and 760 millimeters pressure), and produces upon the galvanometer an angle of deflection of $\alpha°$; now, we have another current of unknown strength x, which is to be measured, which gives upon the tangent galvanometer the deflection $\varphi°$; it is required to find how much inflammable gas would the same have produced in a minute.

In the first place the strength of the currents are in the same proportion as the tangents of the angles of deflection of the tangent galvanometer; hence, is

$$S : x = \text{tang. } \alpha : \text{tang. } \varphi.$$

Then the strength of the currents is likewise in proportion to the volumes of the inflammable gas formed in one minute; hence, also, when we compare S with the current unit

$$1 : S = 1 : a,$$

the multiplication of both proportions gives directly

$$1 : x = \text{tang. } \alpha : a. \text{ tang. } \varphi;$$

hence the strength of current will be

$$x = \left(\frac{a}{\text{tang. } \alpha}\right) \text{tang. } \varphi;$$

a and tang. α, however, are the two known values. If we indicate these quotients

$$\frac{a}{\text{tang. } \alpha},$$

(which evidently indicates the gas compound corresponding with tangent 1,) by z, then we get

$$x = z. \text{ tang. } \varphi;$$

that is to say, to make use of a tangent galvanometer for measuring currents, we must cause any convenient current to pass through the same, and at the same time through a voltameter, and observe accurately the angle of deflection (α) and the quantity of inflammable gas (a) reduced to 0° C, and 760 millimeters; divide the latter (a) by the mathematical tangent of the angle (tang. α), then, once for all, we have in this quotient what is called the reduction factor or multiplier z of that particular galvanometer by which the tangents of the angle of deflection produced by any other current should be multiplied in order to ascertain the strength of this current expressed in Jacobi's units.

Another example will further illustrate this:

The galvanic current from four elements gave, upon a tangent galvanometer, an angle of deflection of $\alpha = 18\frac{1}{4}°$, and in 3 minutes a volume of 78 cubic centimeters of inflammable gas. The temperature of the room was 15° C and the height of the barometer 740 millimeters. The gas was caught over water in the graduated tube (Fig. 11), and the surface of the water stood 10 centimeters higher inside the tube than outside. First of all, the volume of gas is to be reduced from 78 cubic centimeters to 0° C and 760 millimeters pressure. As 760 millimeters of mercury is equal to the pressure of 13.5 × 760 = 10260 millimeters of water, so 10 centimeters or 100 millimeters of water are equal to 7 millimeters of mercury. Hence the gas stood under a pressure of 740 mm. — 7 mm. = 733 mm. mercury. The same gas would, at 0° C and 760 millimeters, occupy a volume of

$$x = \frac{273 \cdot 78 \cdot 733}{(273 + 15)\,760} = 71.3 \text{ cubic centimeters}$$

Hence, in one minute, the current evolved

$$\frac{71.3}{3} = 23.77$$

cubic centimeters of inflammable gas.

The tangent of 18¼°, the angle of deflection, is equal to 0.3394, consequently the multiplier of the galvanometer

$$\frac{a}{\text{tang. } \alpha} = \frac{23.77}{0.3394} = 70.003 \text{ or full } 70.$$

We must now multiply by this figure the tangents of the angle of deflection in order to get at the strength of the current which causes the deflection. If, therefore, on this same galvanometer, at any time, a current gives an angle of deflection of 27°, then the strength of current will be

$$S = 70. \text{ tang. } 27° = 70 . 0.5095 = 35{,}665,$$

that is to say, the latter is 35.665 times as great as that strength of current, which develops in one minute 1 cubic centimeter of inflammable gas. Such a current, therefore, would produce in one minute 35.665 cubic centimeters of inflammable gas in the voltameter.

It must be understood that the reduction factor or multiplier of a tangent galvanometer must be ascertained with the utmost precision, and therefore should not be finally determined by a single experiment, but only after a series of experiments; the mean of the observations being taken as the true result.

If we wish to compare a tangent galvanometer whose reduction factor is yet unknown with another one whose factor is known, then we may pass any current at the same time through both galvanometers, and note the angle of deflection upon each. If this be denoted by α in the case of the known galvanometer, and its reduction factor be r, then we leave for this the strength of current

$$S = r \text{ tang. } \alpha.$$

If the angle of deflection in the unknown galvanometer be ψ, and its unknown reduction factor x, then we have for this the same strength of current,

$$S \quad x \text{ tang. } \psi.$$

Hence, also,

$$x \text{ tang. } \psi = r \text{ tang. } a,$$

and

$$x = \frac{r \text{ tang. } \alpha}{\text{tang. } \psi}$$

out of which immediately results the reduction factor of the unknown galvanometer.

It is evident now, from what has been said, that the reduction factor or multiplier of a tangent galvanometer only answers for that particular instrument for which it has been calculated; the change which it undergoes when the instrument is carried to some other place is exceedingly small, as the intensity of the magnetism of the earth differs very little in different places.

In order to make a sine-galvanometer applicable to measure the currents with the reading of a voltameter, the same method above described is to be adopted.

The average time occupied in the transmission of telegrams between Madrid and England, "*via* Santander," during May was three hours twenty-six minutes, including transmission over Spanish land lines.

TARIFF BUREAU.

SEMI-MONTHLY CIRCULAR.

EXECUTIVE OFFICE,
WESTERN UNION TELEGRAPH COMPANY,
Broadway, cor. Dey street, New York, July 1, 1875.

To all offices on W. U. Lines:

The following changes and additions have been made since the date of the last circular:

GENERAL INFORMATION.

There is no office at East Lyme, Conn. Messages for that place are delivered by special messenger, or by stage which leaves Niantic once daily. Charge for delivery one dollar by messenger, or 25 cents by stage.

In computing the other line tariff on messages to Milton, Navy Yard, near Pensacola, Ferry Pass and Millvue, Fla., count and charge for three words more than the messages contain.

St. Augustine, Fla., reopened.

Waynesville, Ill., closed.

Augusta, Ind., closed.

The square for Fayette, Iowa, will, on and after July 5th, be 376 instead of 386.

Mercers, Ky., closed.

Messages taken for Crab Orchard Springs, Ky., are delivered from Crab Orchard; charges for delivery 25 cents.

Deer Park, Md., reopened.

Barrett's Junction, Mass., closed.

Hereafter the charge for delivery from Boston to Dorchester, Mass., will be 50 cents instead of 15 cents as at present.

In messages to Mexico, words such as La Prairie, St. Louis, New Orleans, San Juan and San Francisco, are counted as two words. East St. Louis, South New Market and East Des Moines are counted as three words.

Au Sable, Mich., closed.

Milton, Mich., changed to Chesterfield.

Oscoda, Mich., reopened

Messages taken for the Michigan State Public School, near Coldwater, Mich., are delivered from the latter place. Charges for delivery, 30 cents.

Dardenne, Mo., changed to St. Peters.

Demarest, N. J., closed.

Martin's, N. Y., reopened.

Hereafter the "tariff for other lines" from Buffalo to points given below will be:

Franklinville,	N. Y.,	40	3.
Ischua,	"	40	3.
Machias,	"	40	3.
Portville,	"	45	3.
Yorkshire Centre,	"	40	3.

NEWFOUNDLAND.—Hereafter the date, address and signature of Newfoundland and St. Pierre M. I. messages will not be counted or charged for.

The tariff on prepaid or received collect Newfoundland and St. Pierre messages will be $2.40 and 24 from W. Union offices in New England and New York City. Messages sent collect or received paid should be checked at rate of 75 and 5. The present mode of checking Newfoundland and St. Pierre business will remain unchanged.

All W. Union offices south and west of New England, except New York City, will add $2.40 and 24 to their rate to New York on prepaid or received collect Newfoundland and St. Pierre messages. On messages sent collect or received paid the rate will be 75 and 5 added to the rate to New York. Check messages as heretofore.

Offices in the Eastern Division which have received recent notice of a change in the rate to Prince Edwards Island are hereby notified that no change to the offices on that Island was intended. The rate will be as formerly, viz: 60 and 4 from Sackville for offices west of N. B., and 50 and 3 from Sackville for offices east of Maine.

Messages taken for the Manhanset Hotel, Shelter Island, should be sent and checked to Greenport, L. I., N. Y.

Green Springs, O., closed.

Kansas, O., closed.

Collins Bay, Ont., reopened.

Courtland, Ont., closed.

Indiana, " closed.

The P. O. A. of Collinwood, O., for the present is Collamer.

Hereafter the "tariff for other lines" from Buffalo, N. Y., to offices in Pa. here given will be as follows:

Eldred, Pa.,	45	3.	
Keating's Summit, McKean Co., Pa.,	50	3.	
Larabee's,	"	40	3.
Port Allegany,	"	50	3.

Morristown, Tenn., closed.

Elmo, Texas, closed.

Black River, Wis., changed to Hatfield.

Lowell, Wis., changed to Reeseville.

Westport, Wis., changed to Mendota.

Camp Stambaugh, Wy., closed.

SUMMER OFFICES REOPENED.

29 Pequot House, New London, Conn.; check New London.
* Bar Harbor, Me.
17 Old Orchard Beach, Me.
21 Pigeon Cove, Mass.
17 Boar's Head, N. H.
17 Farragut House, N. H.
17 Sea View House, "

Messages for Hampton Beach and Rye Beach, N. H., should be sent and checked to Boar's Head and Farragut House, respectively.

47 Deal, N. J.
47 Ocean Grove, N. J.
40 Catskill Mountain House, N. Y.
46 Cozzen's Hotel, W. Point, N. Y.; check West Point.
* Paul Smith's, N. Y.
* Prospect House, Upper Saranac Lake, N. Y.
83 Watkin's Glen, N. Y.
169 Little Mountain, O.
* Narragansett Pier, R. I.
* Oakland Beach, R. I.
* Rocky Point, "
143 Alleghany Springs, Va.
133 Blue Ridge Springs, Va.
103 Jordon's White Sulphur Springs, Va.
* Orkney Springs, Va.
142 Rockbridge Alum Springs, Va.
142 Rockbridge Baths, Va.
143 Sweet Chalybeate Springs, Va.
69 Sewall's Point, Va.
143 Sweet Springs, W. Va.
27 Bethlehem, N. H.
27 Crawford House, N. H.
27 Fabyan House, "
27 Glen House, "
27 Mt. Washington, "
27 Mt. Washington Depot, N. H.
27 Profile House, "
27 Twin Mountain House, "
27 Waumbeck House, "

Business with Mt. Washington will be checked to the Glen House; business with Mt. Washington Depot, check to Fabyan House. Tariff to above-named White Mountain, N. H., offices, in Square 27, is 20 cents more than the usual local, square and State rates.

NEW OFFICES.

29 Niantic, Conn.
* Green Cave Springs, Fla., 50 4 from Lake City.
* Toccoi, Fla., 50 4 from Lake City.
* New Era, Ind., 25 2 from Fort Wayne.
* Fort Sill, Ind. Terr., 25 1 from Denison, Texas.
375 Bayou des Allemands, La.
* Tepic, Mexico, 650 60 from Brownsville, Texas.
200 Chesterfield, Mich. (formerly Milton).
270 Glenwood, Mich.
230 Pittabawassa, Mich.
* Aurora, Minn., 100 7 from Chicago, Ill.
* Good Thunder, Minn., 120 8 " " "
* Mapleton, " 120 8 " " "
* Minnesota Lake, " 120 8 " " "
369 St. Peters, Mo., (formerly Dardenne).
4 Morrison's Mills, N. B.
53 Sea Grove Hotel, Sea Grove Village, N. J. (Summer office). Check Cape May City.
* Ancram, N. Y., 25 2 from Rondout.
120 Cherry Creek, N. Y.
46 Highland House, Garrisons, N. Y. Check Garrisons.
* La Forgeville, N. Y., 25 1 from Utica, Mont. Co.
* Red Hook, N. Y., 25 2 from Rondout.
88 Willseyville, N. Y.
* Coboconk Town, Ont.
* Port Cockburn, "
* Selkirk, "
* St. Eugene, "
* Villa Nova, "
* York, "
85 Gettysburg Springs, Pa. (Summer office). Check Gettysburg.
* Laquerre, Que.
* North Hatley, Que.
* Tanneries West, Que.
* Graham City, Texas, 25 1 from Denison.
* Henrietta, " 25 1 " "
* Jacksboro, " 25 1 " "
* Pilot Point, " 25 1 " "
* Kaufman, Texas, { 90 6 from Marshall. / 75 5 " Dallas.
* Purcellville, Va., 40 3 from Alexandria.
Mayhews, Wis.
* Chelsea, Wis., 100 7 from Chicago, Ill.
* Forest Junction, Wis., 60 4 " " "
* Hatfield, Wis. (formerly Black River), 75 5 " " "
* Kaukauna, Wis., 60 4 " " "
* Mendota, Wis. (formerly Westport), 60 4 " " "
* Norwalk, Wis., 75 5 " " "
* Reeseville, Wis. (formerly Lowell), 50 3 " " "

TO OFFICES HAVING "SHEET C."

Add the following offices in Wisconsin and Minnesota to your "Sheet C" and check them accordingly:

7 Forest Junction, Wis., 56 Good Thunder, Minn.,
15 Kaukauna, Wis., 56 Mapleton, Minn.,
29 Norwalk, Wis., 56 Minnesota Lake, Minn.
47 Aurora, Minn.,

Also the names of following places have been changed:

Black River, Wis., to Hatfield,
Lowell, Wis., to Reeseville,
Westport, Wis., to Mendota.

Government messages to and from Graham City, Henrietta, Jacksboro, Pilot Point, in Texas, and Fort Sill, Ind. Terr. (new offices on other lines), should be charged tariff for "*this line*" *only*. They are transmitted free beyond Denison.

WILLIAM ORTON,
President.

EXECUTIVE OFFICE,
WESTERN UNION TELEGRAPH COMPANY,
NEW YORK, June 29th, 1875.

On Monday, July 5th, office hours will be from eight to ten o'clock, A. M. and from four to six o'clock, P. M., except at repeating stations and principal offices, which will be kept open as usual, with such reduction of force on duty as circumstances may permit.

WILLIAM ORTON,
President.

TRANSFER SERVICE

EXECUTIVE OFFICE,
NEW YORK, June 18, 1875.

On July 10th, Elkhart, Ind., and Hillsdale, Mich. will be discontinued as money-order offices.

On July 12th, Boulder, Colorado, will be added to the list of money-order offices in R. C. Clowry's district.

GEO. H. MUMFORD,
Vice-Prest.

EXECUTIVE OFFICE,
NEW YORK, June 28, 1875.

To all Transfer Agents:

Mr. G. W. Trabue, of Louisville, Ky., has been appointed Transfer Agent for the District heretofore in charge of J. B. Tree, dating from the 1st day of July next.

GEO. H. MUMFORD,
Vice-President.

AN official memorandum from the Great Northern Telegraph Company states that, according to information received from Foochow, an agreement was entered into and signed on the 21st May, between the Chinese Government, represented by the Imperial Commissioner Shen Panchen, Viceroy and General in the Province of Fookien, charged with full powers by Tsung-li-Yamen, Minister for Foreign Affairs in Pekin, and the Great Northern Telegraph Company, to the following effect: "The Chinese Government pays the Company full compensation for the damage done to the Foochow-Amoy line in January last. The Company to erect a line of telegraphs between Foochow and Amoy for account and risk of the Chinese Government. Inland telegraph stations to be established in Amoy, Foochow, and two intermediate towns, Hinghua and Chuenchan. The working of the line to be undertaken by the Company for account of the Chinese Government."

THE TELEGRAPHER'S MUTUAL BENEFIT ASSOCIATION.

RECEIPTS OF ASSESSMENTS.

NEW YORK, June 28, 1875.

ASSESSMENT No. 76.

22, 25, 29, 33, 52, 54, 58, 59, 60, 67, 72, 101, 108, 141, 142, 144, 145, 153, 172, 176, 177, 178, 179, 184, 185, 186, 187, 188, 189, 190, 191, 193, 197, 198, 201, 202, 220, 230, 247, 254, 267, 302, 323, 367, 379, 381, 391, 392, 393, 398, 416, 418, 426, 431, 438, 476, 526, 547, 552, 554, 565, 575, 586, 592, 603, 604, 605, 649, 655, 659, 671, 685, 691, 695, 697, 705, 708, 714, 729, 734, 735, 742, 750, 751, 756, 799, 820, 831, 842, 843, 855, 874, 880, 901, 912, 941, 952, 976, 998, 1001, 1005, 1023, 1040, 1047, 1054, 1071, 1081, 1085, 1088, 1090, 1142, 1147, 1155, 1156, 1157, 1159, 1160, 1162, 1177, 1185, 1196, 1200, 1208, 1225, 1226, 1227, 1233, 1273, 1276, 1282, 1304, 1325, 1364, 1365, 1385, 1390, 1391, 1400, 1402, 1403, 1404, 1407, 1410, 1417, 1426, 1440, 1448, 1484, 1498, 1505, 1524, 1531, 1554, 1555, 1556, 1557, 1569, 1570, 1582, 1593, 1594, 1613, 1615, 1620, 1623, 1626, 1630, 1635, 1644, 1656, 1670, 1681, 1684, 1687, 1688, 1695, 1707, 1709, 1710, 1713, 1721, 1723, 1724, 1729, 1745, 1773, 1775, 1790, 1791, 1796, 1799, 1809, 1810, 1811, 1812, 1839, 1840, 1841, 1847, 1852, 1869, 1903, 1907, 1917, 1919, 1922, 1924, 1926, 1938, 1942, 1945, 1946, 1965, 1972, 1985, 1987, 1991, 2015, 2021, 2025, 2027, 2029, 2041, 2044, 2045, 2069, 2072, 2083, 2089, 2103, 2113, 2114, 2118, 2141, 2142, 2151, 2159, 2172, 2175, 2180, 2181, 2183, 2184, 2185, 2191, 2196, 2200, 2201, 2204, 2205, 2206, 2212, 2214, 2216, 2221, 2234, 2236, 2243, 2248, 2250, 2263, 2273, 2290, 2295, 2296, 2297, 2298, 2299, 2306, 2313, 2314, 2316, 2317, 2319, 2330, 2331, 2333, 2334, 2335, 2336, 2341, 2342, 2344, 2349, 2351, 2358 2367, 2373, 2379, 2381, 2385, 2387, 2388, 2390, 2391, 2392, 2393, 2394, 2396, 2403, 2412, 2413, 2417, 2418, 2419, 2421, 2424, 2431, 2432, 2433.

ASSESSMENT No. 75.

113, 566, 594, 1098, 1232, 1267, 1572, 1590, 1619, 1678, 1713, 2024, 2038, 2048, 2238, 2257, 2261, 2280, 2355, 2356. 2378, 2380.

ASSESSMENT No. 74.

863, 1207, 1609, 2128.

Members of the Association who look to the JOURNAL OF THE TELEGRAPH for receipt of assessments paid, will please take notice that an acknowledgment of the receipt of one assessment should be taken as a receipt for all previous assessments.

THE FIFTH INTERNATIONAL TELEGRAPH CONFERENCE.

The Fifth International Telegraph Conference assembled at St. Petersburg, Russia, on the 2d ult. Representatives from all foreign countries and foreign telegraphic administrations are present, the British Postal Telegraph Department being represented by Mr. H. C. Fischer, the Controller of the Central Telegraph Station in London, and Mr. Allan E. Chambre, the Surveyor of the Private Wire Branch of the department. Col. Robinson with Maj. Bateman represent the Indian Telegraph Department; Sir James Anderson and Mr. Lewis Wells (formerly of the Electric and International Telegraph Company) the Eastern Telegraph Company; Sir James Carmichael and Mr. S. M. Clare the Submarine Company; Mr. Andrews the Indo-European Company, and Mr. H. G. Erichsen the Great Northern Company.

The principal business of the conference will be the codification of regulations arrived at on previous meetings, so as to secure some uniformity in the treatment of international messages. An important proposition, having for its object the reduction of the minimum number of words in foreign European messages from 20 to 10, and a corresponding reduction of the tariff for such messages, will be brought forward; and the attention of the conference will be asked to a somewhat similar proposition with regard to extra European messages. The sittings of the conference will, it is anticipated, extend over a period of six weeks.

Mr. E. W. BARNES has been appointed Manager of the New Orleans, La., office.

THE SIXTH CINCINNATI EXPOSITION.

The Sixth Cincinnati Industrial Exposition will open to the public on Wednesday, September 8th, and continue until Saturday, October 9th. This year the Managers have decided to form a distinct class of the electrical and telegraphic apparatus and supplies, and offer no less than thirty-five premiums to exhibitors of this class of machinery. The following is the list:

Best System for Simultaneous Transmission of two or more messages over same wire (in operation)	Gold Medal.
Best System for Automatic Telegraphy (in operation)	" "
Best System for Fire Alarm Telegraphy (in operation)	" "
Best System for Private Line Telegraph (in operation	Silver Medal.
Best System for Transmission of Musical Sounds by Electricity	" "
Best System for Automatic Fire Alarm Telegraph (in operation)	" "
Best System for Telegraphic Railway Signal	" "
" " " Adaptation of the Telegraph to Domestic Use	" "
Best Fire Alarm Signal Box	" "
" Display of Instruments and Supplies	" "
" Instrument for Quotations	" "
" Electric Engine, Motor for Light Work	" "
" Galvanometer	Bronze Medal.
" Telegraph Battery	" "
" Electric Light	" "
" Electric Hotel Annunciator	" "
" Box Relay, Key attached	" "
" Pocket Relay Magnet	" "
" Morse Register	" "
" Single Cut-Out	" "
" Switch for from four to twenty Wires	" "
" Telegraph Set (Key, Sounder and Relay)	Silver Medal.
" Electric Magnetic Motor	" "
" Magnetic Watchman's Clock	" "
" Printing Instrument for Private Line	" "
" Dial Instrument for Private Line	" "
" Coil Wire	Bronze Medal.
" Sample Office and Magnet Wire	" "
" Submarine Cable	" "
" Air Cable	" "
" Amateur Instrument	" "
" Insulator	" "
" Electric Gas Lighting Apparatus	" "
" Burglar Alarm	" "
" Electric Clock	" "

THE TELEGRAPH IN EGYPT.

In the later years of the life of Mahomet Ali he caused a semaphoric telegraph to be established for communication between Alexandria and Cairo. There were seventeen stations intermediate between these terminal points, and signaled from one to another with so much rapidity that messages from Cairo were received at Alexandria in forty minutes, and the chronicler takes pains to add: "Those from Alexandria were received at Cairo in the same interval of time." This mode of telegraphic communication of course yielded to the electric telegraph, by which Cairo is now connected not only with Alexandria, but with the most remote parts of Egypt, there being more than four thousand miles length of line, and double that extent of wire. The whole is operated by the Morse instruments. The submarine telegraphs in the Mediterranean on the one side and in the Red Sea and Indian Ocean on the other, of course complete the telegraphic communication with every part of the world. Despatches between Cairo and Washington are, in fact, exchanged within twenty-four hours, including all delays in transmission and the necessary pause for the preparation of answers.

WEST INDIA AND PANAMA TELEGRAPH.—The traffic receipts amounted for the month of March to £4,705, as compared with £2,447 in the corresponding month of 1874.

CORRESPONDENCE.

TESTS OF INSULATION.

NASHVILLE, TENN., June 23, 1875.

To the Editor of the Journal of the Telegraph:

Presuming that the tests published in the JOURNAL of June 15th as deemed worthy of record are so deemed as exhibiting the comparative merits of the several insulators, it is proper to be stated that the test of square glass exhibited therein is not a fair average one. For example: the resistance of line No. 9 was 808,260, which is the lowest of eight tests, averaging 1½ to 2 megohms; line No. 1 was 692,094, the lowest of two tests, the other being 1,067,040; and line No. 4 was 665,406, the lowest of seven tests ranging up to 3,000,000 and averaging 1,500,000. These include all real wet-weather tests in about twelve months, the rains ranging from 8 to 24 hours.

It should be stated also that the particular pin and glass referred to in Kentucky are all P. & A. cemented insulators, with a single exception. The exception, a screw glass, is reported 3,507,666, which is in fact one of the lowest of eleven tests of the same line, three being over 6,000,000, one after 18 hours' and 2 after 8 hours' rains.

The exhibited test of cemented glass lines Nos. 2 and 5 are also, with one exception, the lowest test made of these lines.

The square glass is an inferior insulator to the pin and glass, but is in some cases much the most serviceable, and should be fairly reported.

I will add that the recorded test for conductivity of the Kentucky lines, like that for insulation, is in every instance worse than the average of each wire reported in the last descriptive reports.

Altogether the test of Kentucky lines is about the most unfavorable one made since the galvanometer came into general use, and as such exceptional tests do not afford reliable conclusions, they should not be deemed worthy of record. G. W. T.

THE TELEGRAPH IN WESTERN AUSTRALIA

Almost all the towns of Western Australia are now connected by telegraphic wires. Albany, King George's Sound, is united with Perth, the capital, whence wires run to every place of importance north and south, with the exception of Geraldton. As the work of telegraphic extension is rapidly progressing, it is expected that in a short time a line will be carried to the last-mentioned town. The colonial parliament has voted £15,000 for the construction of a line from Western Australia to South Australia. The charge made for the transmission of messages between any two stations in Western Australia is 1s. for the first ten words, and 6d. for each additional word.

A NEW SWINDLING DODGE.

It has remained for a St. Louis artist to devise and attempt a swindling scheme which is admirable for its novelty, though it chanced to fail at the first time, and is of no further value. The device consists in bringing two telegraphic dispatches and a signature book to a wealthy man for his signature, the page of the book being so cut and underlaid with a blank check that the signing of the name twice would give the clever operator a check both endorsed and signed. The business man narrowly escaped the trap, which failed for lack of a little forethought, as the paper beneath, not being securely fastened, slipped enough to attract attention as the name was being signed the second time. This small circumstance defeated the pretty plan, and saved the discoverer a big deficit in his bank account.

Journal of the Telegraph.

This Journal is issued on the 1st and 15th of each month. Its circulation is over 8,000. It goes to every State, Territory and Province on the Continent. It has become a necessity, and is always welcomed as a friend. No better medium for advertising exists.

TERMS:

TWO DOLLARS PER ANNUM IN ADVANCE.

Address—

JOURNAL OF THE TELEGRAPH,

Western Union Telegraph Company,

195 Broadway, New York.

NEW YORK, JULY 1, 1875.

NOTICE OF REMITTANCES.

We call again attention to the order of the Treasurer directing a notice by postal card of remittances. *That order will be enforced.* To prevent it being overlooked we insert it here, and request prompt and universal compliance therewith:

TO ALL SUPERINTENDENTS AND MANAGERS.

Hereafter, notice must be sent to J. B. Van Every, Auditor, by postal card, of every remittance to the Treasurer.

These notices must, in every case, be mailed on the same day that the remittance is sent.

They will not take the place of blank No. 65, *which must be enclosed with the remittance, as hitherto.*

The advice which has heretofore been sent (by some offices) to the Treasurer, *separately from the remittance*, may be discontinued.

R. H. ROCHESTER, *Treasurer.*

NEW YORK, June 15, 1875.

SUPERINTENDENTS and managers are informed that the new form, No. 68, is a printed postal card, to be used in sending notice to the Auditor of remittances made to the Treasurer. These forms can be obtained by requisition upon the Supply Department.

THE regular quarterly dividend of the Western Union Telegraph Company, two per cent., declared June 9th, is payable at the office of the Treasurer of the Company, Western Union Telegraph Building, on and after July 15th. The transfer books are closed until July 16th.

Mr. GEO. W. TRABUE has been appointed Superintendent of the Second District of the Southern Division, in the place of Mr. J. B. Tree. The Headquarters of the District will soon be removed to Nashville, Tenn., but will continue at Louisville, Ky., until further notice.

THE U. S. DIRECT CABLE.

It is more than a year since the steamer *Faraday*, built especially for the work, and supposed to be, in her adaptations, superior to any other ship that had ever been employed in the work of laying cables, not excepting even the *Great Eastern*, started from the coast of Ireland to lay a cable, whose friends alleged was not only to compete successfully with the four cables of the Anglo-American Company, but, through its connection with the great Atlantic and Pacific Company of the United States, was to effect the destruction of the Western Union.

We will not speak now of the accidents, the tribulations and disappointments which have befallen the enterprise. Only a few weeks ago it was announced that the final effort to recover the numerously lost cable had been successful, and that its operation was about to commence. Since then, however, it has been ominously silent, and we now learn from an authentic source, that, after the connection between the coasts of the United States and Ireland had been made, it was found that the cable would not work successfully by reason of a serious fault in water a thousand fathoms deep; that the *Faraday* had been dispatched to repair the fault, and has succeeded only in again breaking the cable.

There is reason to believe that even if it shall be recovered, and this particular fault be cut out, that the rough treatment to which the cable has been subjected during the past year has injured it so seriously that it will never be able to perform satisfactory work.

WHOSE CHILD IS IT?

There was always to us something deeply pathetic in the very name of Marryatt's novel, in which he describes a poor youth, named Japhet, in search of his father. Orphanhood of such a character and under such circumstances struck our young imagination, as it came up before us many years ago, as specially sad. Since that time, however, we have listened to the pip of so many chickens after parental hens that Japhet had faded from our memory, and we were conscious of having become hardened to that department of the world's sorrow. Recently, however, a new phase of misery has come up before us in the case of an over-fathered child, which first by one parent, and then trotted out by another as its responsible father, asks for a portion of the world's compassion. The object of our special concern, while we now write, is our friend George Little, C. E., of Passaic City, N. J., who comes before the public in the following unique advertisements as the original incubator, parent hen, and father in general, ahead of all other parents, of the *American Automatic Telegraph*, and claims the right of eminent domain over his offspring. We give him the privilege of speaking first, for we know he has been sitting on automatic eggs long enough to have raised a very respectable brood.

ADVERTISEMENT No. 1.

☞ "American Automatic Telegraph." ☜

The only reliable and economical SYSTEM for "POSTAL" and commercial services. Is now in use on the lines of the ATLANTIC and PACIFIC Telegraph Company. The right, title and claims to the above being my exclusive property, which I now offer for sale. The price being $50,000 in gold (for thirty-seven United States Patents), in part cash and good security.

The same SYSTEM as used by the LATE Automatic Telegraph Company during the past four years.

GEORGE LITTLE, Passaic City, New Jersey.

June 23, 1875.

ADVERTISEMENT No. 2.

☞ Little's, or, the "American Automatic Telegraph." ☜

WILL the ATLANTIC AND PACIFIC TELEGRAPH COMPANY of the CITY OF NEW YORK—or any other parties—inform the public and me, the undersigned, when and where the RIGHT, TITLE and CLAIMS to the above SYSTEM was sold, and by whom and upon whose authority? If so, what was the consideration, and who paid the same? I hereby publicly declare that said system is not sold, and no consideration has been received by me. To the contrary, I have a SALARY claim against the LATE Automatic Telegraph Company of TEN Thousand Dollars, with a continuous claim for salary of four hundred dollars PER MONTH during the LIFETIME of MY PATENTS, independent of ROYALTY claims.

I hereby inform all parties concerned that FOUR HUNDRED THOUSAND DOLLARS was expended upon machinery and apparatus supposed to have been got up in the name and interest of one EDISON of NEWARK, N. J., entirely against MY ADVICE. FIFTEEN PER CENT., by a PRIVATE contract, went to the President of the LATE Automatic Telegraph Company, GEORGE HARRINGTON, of Washington, D. C. THIS is a reply to the annexed communication, just received by me, and signed J. C. REIFF (postmarked June 22 inst.)

GEORGE LITTLE, Passaic City, New Jersey.

June 23, 1875.

FIFTH AVENUE HOTEL, NEW YORK.

MR. LITTLE:

WILL you please call to see me the next time you are in NEW YORK? What possible good do you suppose can be done by PUBLICLY advertising to sell what you sold years ago. YOU have already sufficiently damaged your own interest without committing actual suicide. Resp., J. C. REIFF.

Now, is not this the very child which the President of the Atlantic and Pacific Company announced as the offspring of 36 patents, and as having been *acquired* by that delightful Company? And where is Edison, and Craig, and Harrington, and all the other fathers and foregatherers in the automatic nest? And is it not true that if there be any value at all in the automatic system as developed in America, it is due to a parentage as yet unnamed, and the fruits of whose invention have been, with sublime impudence, *acquired* by these pawnbrokers of stolen goods.

CHANGE IN GOVERNMENT RATES.

By invitation of the Postmaster-General, a conference between that officer and Presidents Orton, of the Western Union, and Blossom, of the Southern and Atlantic Company, and a representative of the Atlantic and Pacific Company, took place on Tuesday, 29th ult., the subject being a contemplated reduction in the rates now paid by the Government for telegraphic service. The conference was satisfactory, and resulted in the adoption of Mr. Orton's proposition that the word-rate remain as at present, one cent for each circuit of 250 miles, the maximum number of circuits for which the Government shall pay on any one message, however, to be limited to ten.

BATTERY COVERS.

When it was proposed to use oil on the surface of the cells of the gravity battery to prevent evaporation, it was thought a very simple and effective and economical device. No doubt it was, and is; and yet oil is an unpleasant element. To cleanly hands it is offensive. In warm weather or in a heated room it has an odor very ungrateful to the ordinary sense; and even with its use in preventing evaporation, it is usually found necessary to add water, at least monthly, as well as to clean the parts—which latter, by reason of the oil, is far from being a pleasant duty.

Mr. Geo. F. Milliken, manager of the Boston office of the Western Union Telegraph Co., writes as follows in reference to this subject:

"I have now in the battery room a few cells without oil with wooden covers—one with zinc, one tin. The metallic covers are made with a rim one inch wide, fitting the cell, but not too closely. The openings for the wires and the space round the rim are filled with paraffine and tallow. They were set up May 7th for use in local circuits, and now (June 24th), without a drop of water added to them, there is no sign of diminution, and all are clean and neat as at first. The wooden coverings were put on May 19th, and the cells look well. These covers can be made for less than the cost of oil, and are permanent."

All experiments of this kind are valuable, and to us it appears particularly so when any improvement is suggested which tends to cleanliness and neatness as well as economy. We think it not unlikely that Mr. Milliken's experience, if confirmed by prolonged tests, may lead to a change in the present directions respecting the use of oil in batteries.

The messenger boys of the American District Telegraph Company, 400 strong, parade on Broadway, New York, July 5th. The finely drilled Boy Band of the Soldiers' and Sailors' Orphan Home, in new and handsome uniform, led by Col. Johnston, of the Home, provide the music. Many of the boys in this Band are expert telegraph operators, having been instructed at the Home by a competent teacher. If the day is fine the parade will be very attractive.

We have received the "Manual of Telegraphy and Catalogue of Private Line Instruments," issued by the Western Electric Manufacturing Company of Chicago. The Manual, which has been prepared by Mr. George H. Bliss, the General Agent of that Company, contains much useful information for beginners in the art, besides a number of easy lessons in dots and dashes.

The American District Telegraph system is being introduced in New Orleans, La., under favorable auspices. The company has been organized under the laws of Louisiana, and are now engaged in constructing their lines and fitting up their offices, and announce that they will be prepared to commence business on the first of September next.

THE GOVERNMENT OF CANADA AND THE TELEGRAPHS.

[*From the Railway News.*]

A correspondent in Canada has forwarded an official copy of the protest of the minority of the Senate which disapproved the passing of the Act by which the Government of Canada has, with such short-sighted policy, sought to interfere with the vested rights of the Anglo-American Telegraph Company. On a previous occasion we gave the substance of this protest, but we did not give the names of the senators who had signed the document. Our correspondent states that he fully approves of everything that we stated "with respect to this unnecessary and wanton interference on the part of the Government of the Dominion," but thinks "that the names of the gentlemen who opposed the passing of this impolitic measure should be known in England, and that the whole of the members of the Senate should not be censured for an Act which an influential section resolutely but vainly opposed." Our opinion of the impolicy of this Act has been freely given on several occasions. We have pleasure, therefore, in complying with the wish of our correspondent, and give the protest of the dissentient members of the Senate to the third reading of the bill in the House of Commons entitled "An Act to regulate the construction and maintenance of Marine Electric Telegraphs," as amended by the Committee on Banking, Commerce and Railways—

"First.—Because the Act of the Nova Scotia Legislature incorporating the Nova Scotia Electric Telegraph Company in 1851 authorized them to build telegraph lines to any part of the province, 'and through, across and under any stream, gulf, strait or body of water.' They accordingly laid a cable across the navigable strait of Canso, and on the 5th of August, 1855, entered into a written agreement with the New York, Newfoundland and London Company, granting them the privilege of landing a submarine cable in Cape Breton, and making a land line to connect with the Nova Scotia wires at Port Hood, 'in the name and under the authority of the Nova Scotia Company;' and under this agreement the cable was laid in 1856, land lines built, and several cables between the two islands, with hundreds of miles of land wire over Cape Breton, were subsequently built under similar agreements, and have continued ever since to be used without molestation.

"Second.—Because it appears from a report of a committee of the Nova Scotia Assembly in 1857, including the Attorney and Solicitor General, that they were not only aware of the first cable being laid, but approved of it, and the three branches of the Legislature in 1857 passed an Act validating these agreements, which was disallowed in 1858 on the sole ground that it gave exclusive privilege of landing cables for twenty-five years.

"Third.—Because, after this long and uninterrupted acquiescence, it is not desirable nor proper to legislate so as to compel the Anglo-American Company to remove their wires at three months' notice, unless they yield up a privilege acquired twenty-one years ago by an Act of the Newfoundland Legislature, approved by the Queen, and since recognized by the Prince Edward Island Legislature, by the Legislature of United Canada in 1855, by the Imperial Parliament in the Act incorporating the Atlantic Telegraph Company in 1857, and subsequently in the General Telegraph Act of 1863; all these acts being still in force, and agreements having been made under them with the Imperial Government and the United States Government for transmission of messages over the existing lines, and it would be a great wrong to override rights thus acquired.

"Fourth.—Because it is not in the public interest thus to deprive the Dominion of the benefits of telegraphic communication with Newfoundland, and of open competition through the existing cables with any future company, and thereby prevent cheap telegraphy, and probably place the public at the mercy of a single company with a single wire from the Dominion, with unlimited powers of tariff charges.

"Fifth.—Because the bill is unnecessary, inasmuch as the shores of Nova Scotia are open to free competition, and cables may be landed direct from Ireland or *via* St. Pierre, where a much longer cable than from Ireland to Newfoundland has been laid and worked, and where there is no exclusive privilege, the route from Scotland *via* the St. Lawrence being also available.

"Sixth.—Because the effect of the bill being carried out would be to depreciate the Nova Scotia Company's line, and imperil the keeping up of the local and non-paying lines by taking the remunerative cable business from the paying portion of the lines.

"Seventh.—Because the policy of withdrawing the exclusive privilege, without which the Atlantic cable would not have been undertaken, is a question to be settled between the Newfoundland Government and the Legislature and the Anglo-American Company, and it is unwise to coerce the people of Newfoundland by a threat of non-intercourse into the alternative of pre-emption at enormous cost, of which we pay no part, or telegraphic disconnection from their fellow colonists.

"Eighth.—Because this legislation is partial in prohibiting any interchange of messages between existing Canadian companies and a company enjoying a monopoly in Newfoundland, while permitting it to a favored company with all the world where monopolies exist except Newfoundland and Denmark.

"Ninth.—Because the legislation is *ex post facto*, contains no reservation of existing rights, and is calculated to affect injuriously our credit abroad."

(Signed) John Hamilton (Kingston), David Wark, R. B. Dickey, H. A. N. Kaulbach, J. C. Chapais, D. Reesor, Robert Reid, George W. Howlan, Clement F. Cornwall, W. O. Truedel, Joseph H. Bellerose, *J. C. Aikins, Alexander Vidal, A. E. Botsford, J. Skead, †G. W. Allan, †T. Ryan.

The Senate, Saturday, March 20, 1875.

THE LIZARD LIGHTS.

The lights at the Lizard are now undergoing considerable alterations. New lanterns are in course of construction. The source of light in future will be the magnetic electric, on the principle invented by Professor Holmes, combining all the latest improvements which he has lately made. The dioptric apparatus has been specially designed and constructed for the magnetic electric light. The machines for the production of these lights will be worked by Ericcson's caloric engines in lieu of the steam engines hitherto in use, thus entirely removing all risk of explosions and the necessity of water supply. It is intended also to establish a powerful "Syren" fog signal at this station to warn mariners, in thick weather, of their proximity to the coast. This Syren will be worked by the same engine. The works are being rapidly carried forward, and it is expected that the lights will be exhibited by next Christmas.

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* Dissents for the 5th, 7th, and subsequent reasons.

† Dissentients for the 5th, 7th, and subsequent reasons, and also for the further reason that the bill does not appear to be a *bona fide* public measure, but introduced mainly at the instance and in the interests, of a particular company, and directed in a great measure against the rights and interests of another company.

FOREIGN ITEMS.

CUBA SUBMARINE.—The number of messages sent over this Company's lines during the month of May (including those received at the new station in Cienfuegos) was 2,481, estimated to produce £2,400, against 1,788 messages, producing £1,851, in the corresponding month of last year. The actual receipts for the three months ending March amounted to £7,154, as compared with the estimated amount of £7,100.

EASTERN TELEGRAPH.—The traffic receipts for the month of May, 1875, amounted to £30,602, and in the corresponding period of 1874 to £30,225.

THE Indo-European Telegraph Company notify that the average time in transit between London and India, *via* Teheran, of all outward messages to India, including the messages for Penang, Singapore, China, Japan, Java, and Australia, during the week ending the 4th inst., was one hour seventeen minutes.

THE construction of a new land line of telegraph between Amoy and Foochow has commenced in virtue of the agreement lately concluded with the Chinese Government by the Great Northern Telegraph Company.

THE Secretary of the West India and Panama Telegraph Company announce that information has been received of the interruption of two of the Company's cables, viz., between St. Thomas and St Kitts, and between Grenada and Trinidad, in consequence of which telegraphic communication with St. Kitts, Antigua, Guadaloupe, Dominica, Martinique, St. Lucia, St. Vincent, Barbadoes, and Grenada, is for the present suspended. The Company's ship (screw steamer) Investigator has already left St. Thomas to effect the repairs. The repair of either of the broken cables will restore telegraphic communication with the islands cut off. The interruption of the cables named does not interfere with telegraphic communication with Jamaica, Panama, Porto Rico, St. Thomas, St. Croix, Trinidad, Demerara, and Berbice.

THE new cable about to be laid between Australia and New Zealand, in connection with the Eastern Extension Telegraph Company's system, will receive special guarantees as to rates from the New Zealand Government. The contract for the new cable will be undertaken by the Telegraph Construction and Maintenance Company.

HOW INVENTIONS ARE MADE.

The life of George Stephenson proves that, notwithstanding the novelty and great importance of his improvements in steam transit, he did not discover these improvements. He did not discover that a floating embankment would carry a railway across Chat Moss, neither did he discover that the friction between the wheels of a locomotive and the rails would enable a train to be drawn by tractive power alone. Everything connected with his history shows that all his improvements were founded on a method of reasoning from principles, and generally inductively; to say that he "discovered" our railway system, according to the ordinary construction of the term, would be to detract from his hard and well-earned reputation, and place him among a class of fortunate schemers who can claim no place in the history of legitimate engineering.

Count Rumford did not by chance develop the philosophy of forces, upon which we may say the whole science of dynamics now rests. He set out, upon a methodical plan, to demonstrate conceptions that were already matured in his mind, and to verify principles which he had assumed by inductive reasoning.

The greater part of really great and substantial improvements which have performed any considerable part in developing modern mechanical engineering have come through this course of first dealing with primary principles, instead of groping about blindly after mechanical expedients; and present circumstances point to a time not far distant when chance discovery will quite disappear.—*Engineering.*

MUSIC WITHOUT HANDS.

AN ELECTRICAL MACHINE THAT READS NOTES AND PLAYS AN ORGAN WITH TWO HUNDRED FINGERS.

[From the N. Y. Tribune.]

PHILADELPHIA, June 11.—The acme of machine-music appears to have been attained in an ingenious invention just perfected by Messrs. Schmoele of this city, which was exhibited last evening in Horticultural Hall to a few invited guests. The apparatus reads notes and plays upon an organ with absolute correctness of time and touch, the only assistance given it by the operator being to feed in the end of a roll of music and start the machinery in motion. Organs have been played by electricity before, but the only part performed by the electric fluid has been to transmit the power from a distant bank of keys to open the valves of the instrument. Such an electrical organ has been exhibited in London for some time past. In the Schmoele instrument the electric current is endued with a seeming intelligence, and distinguishes the notes in the same way that a blind man does—by feeling. Marvelous as this appears at first thought, it is simple enough. The score is written on a long roll of stout paper by cutting holes through it in the form of squares, or parallelograms. The reading instrument, which is about as large as a sewing-machine, is provided with a multitude of small brass fingers, each of which is connected by a wire with the pipe of the organ which it operates. The roll of music is fed in over a brass tube. When the fingers rest on the paper no electric current is transmitted, because paper is a non-conductor; but whenever they fall into the holes cut in it they touch the brass below, the current is transmitted, and the sound produced.

The length of the note is governed by the length of the slit in the paper. A noiseless bellows-machine, run by wind conducted through a pipe from the organ, works the feeding apparatus. To aid in producing orchestral effects, drums, cymbals, bells, &c., are added to the ordinary pipe organ, and operated by electricity in the same manner as the pipes. A greatly increased volume of sound and much richer harmonic combinations can be made by this instrument than it is possible for a single performer to produce upon an organ, in consequence of the fact that the performer has only his ten fingers, while the electrical machine has 200, and can strike as many notes at once as desired. All the notes on the organ that can be combined into a chord can be brought out together. The overtures to "Semiramide" and "William Tell" were performed last evening with pleasing effect. As the reading instrument is mechanically accurate, and the score correctly written, there were of course no false notes. It was obviously machine music, however, but machine music of the highest order, and might have been mistaken for the performance of a well drilled but rather spiritless orchestra. The inventors hope soon to apply their device to a piano.

OPERATORS' CHANCE.

ELECTROTYPE Cards of Key, Sounder and Relay, with your name printed in handsome type on 25 extra fine Bristol, white and tinted, for 25c., or 50, with business and address, for 50c. Samples 3c. Railroad Operators send 10 cents extra for conductor's and brakeman's electrotype cards. You can make money. Agents outfits, with the handsomest and most stylish cards printed, for 25c. Address,

F. P. MUNN,
Clyde, Wayne County, N. Y.

WESTERN UNION TELEGRAPH CO.,
TREASURER'S OFFICE,
NEW YORK, June 9th, 1875.

DIVIDEND No. 33.

THE BOARD OF DIRECTORS have declared a Quarterly Dividend of **TWO PER CENT.** on the Capital Stock of this Company, from the net earnings of the three months ending June 30th instant, payable at the office of the Treasurer, on and after the 15th day of July next, to shareholders of record on the 19th day of June.

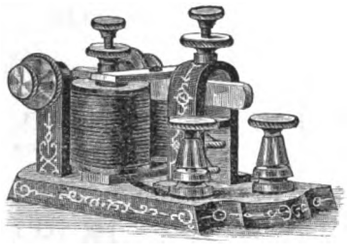
The transfer books will be closed at three o'clock on the afternoon of the 19th inst., and opened on the morning of the 16th of July.

R. H. ROCHESTER,
Treasurer.

WANTED—BY YOUNG MAN, FAIR OPERATOR, PLACE with some western Railroad Agent where he could earn his board and learn Railroad business; best of references furnished. Address, OPERATOR, Drawer 140, Janesville, Wis.

A Great Reduction in Prices.

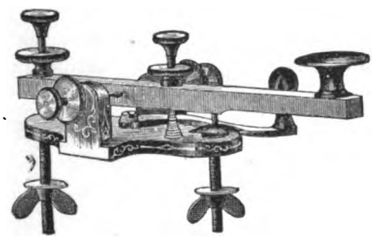
I am now making a specialty of my PHIL. SHERIDAN SOUNDER AND KEY, and am manufacturing them in large quantities, so that I am able to offer them to the public at a very low figure.



PHIL. SHERIDAN, $4.00.

The above cut represents a beautiful little Sounder. It is made of the best material and highly finished. It has a heavy lever, full sized magnets, and altogether it is a first-class instrument. The magnets are wound with green silk insulated wire.

Polished Rubber Covers, 50c. Extra.



PHIL. SHERIDAN KEY, PRICE $2.00.

You can see at once that the above cut represents a first-class Key in every respect. It is highly finished, has large platinum points, strong lever, friction circuit-closer, spring adjustments, &c., &c. As a Learner's set they have no equal, as they are regular Telegraph Instruments, same as are used on all railroad and commercial lines.

One Cell Callaud Battery, 1 lb. Blue Vitriol, Connection Wire, Book of Instruction, &c., all for $1.50. Making a Complete Outfit for office, only $7.50.

These Instruments will be made to work on from a few feet to 5 miles of line, at the same price. Parties ordering, please give length of line that instruments are to be used on. Every set warranted to be just as represented and to give entire satisfaction.

All kinds of Telegraph Instruments and Supplies constantly on hand at the lowest price.

Goods will be sent C. O. D., or on receipt of price. Send stamp for Price List and Catalogue.

A. B. LYMAN,
91½ SENECA ST., Cleveland, Ohio.

CALLAUD BATTERY,

KEPT ON HAND,
AND
Orders filled by
W. MITCHELL McALLISTER,
728 Chestnut Street, Philadelphia,
AND
CHARLES WILLIAMS Jr.,
109 Court St., BOSTON, MASS.
AND BY
THE WESTERN ELECTRIC MANUF'G CO.,
Agents for the United States,
220 Kinzie St., Chicago, Ill.

LECLANCHE BATTERIES.

IMPORTANT NOTICE.

After January 1st, 1875, we will allow **20 Cents** for each used up Porous Cell of this Battery that is returned to us free of charge in good order. A change is made in the discount to the trade.

A list will be furnished on application to

THE LECLANCHE BATTERY CO.,
40 West 18th St.

Or to L. G. TILLOTSON & CO.,
Sole Agents,
8 Dey St.

PHILADELPHIA: 54 South Fourth Street.
CINCINNATI: 22 West Fourth Street.

The "Snapper" Sounder.

PATENTED MARCH 2, 1875.
Polished, 30c., or 6 for $1.50.
Polished nickel-plated base, 50c., or 6 for $2.
Polished, with knob and screw fastenings, 75c.

PRICE  75 CENTS.

Sent post-paid on receipt of price.

R. W. POPE, Box 5278, N. Y.

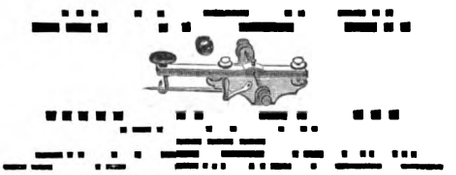
EUGENE F. PHILLIPS,

MANUFACTURER OF

Reed & Phillips' Patent Finished Insulated Telegraph Wire,

PATENT RUBBER-COVERED WIRE,
PATENT ELECTRIC-CORDAGE, CABLES, &c.,

No. 20 CONDUIT STREET,
PROVIDENCE, R. I.



SENT ON RECEIPT OF PRICE.

26 & 27 Waring Block, Cleveland, O.

AMERICAN LINE.

Weekly Mail Steamship service between
PHILADELPHIA AND LIVERPOOL,
CALLING AT QUEENSTOWN,

Sailing every Thursday from Philadelphia, and Sailing every Wednesday from Liverpool.

The following Steamers are appointed to sail from Philadelphia.

PENNSYLVANIA,	June 24.	OHIO,	July 15.
INDIANA,	July 1.	ILLINOIS,	July 22.
*ABBOTSFORD,	July 8.	*KENILWORTH,	July 29.

PRICES OF PASSAGE IN CURRENCY.

Cabin, $100.

Steerage and Intermediate tickets to and from all points at the lowest rates.

Steamers marked with a STAR do not carry intermediate.

Passenger accommodations for all classes unsurpassed.

For passage, rates of freight and other information apply to

GEO. W. COLTON, Agent, 42 Broad Street, N. Y.
JOHN McDONALD, Passenger Agent, 8 Battery Place, N. Y.
PETER WRIGHT & SONS, General Agents, 307 Walnut Street, Philadelphia.
Richardson, Spence & Co., Liverpool. | N. & J. Cummins & Bros., Queenstown.

Red Star Line.

Appointed to carry the Belgian and United States Mails.

The following Steamers are appointed to sail

FOR ANTWERP.

From Philadelphia.		From New York.	
VADERLAND,	July 8.	State of Nevada,	June 26.
NEDERLAND,	July 31.	SWITZERLAND,	July 20.

FROM ANTWERP.

For Philadelphia.		For New York.	
NEDERLAND,	July 8.	SWITZERLAND,	June 26.
VADERLAND,	Aug. 1.	State of Nevada,	July 20.

PRICES OF PASSAGE IN CURRENCY.

First Cabin, - - - $90. Second Cabin, - - $60.

Steerage tickets to and from all points at the lowest rates.

Passenger accomodations for all classes unsurpassed.

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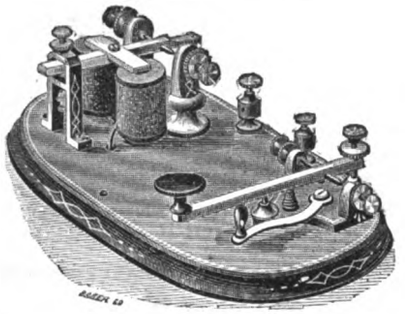

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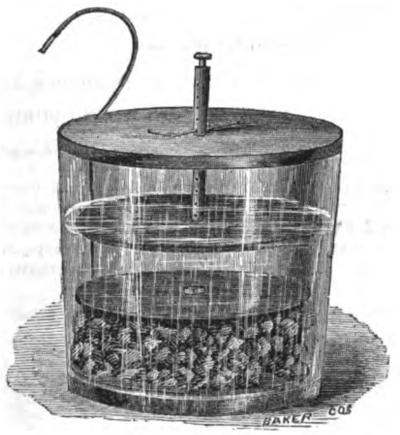

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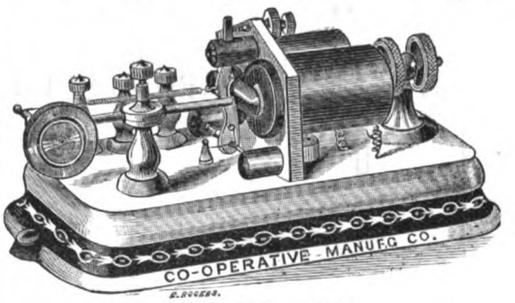

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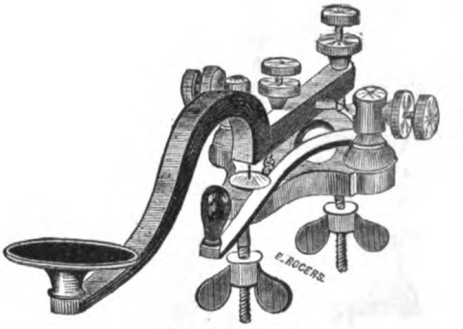

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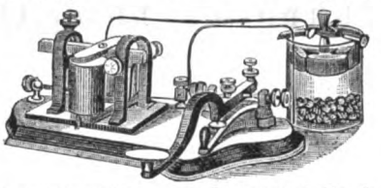

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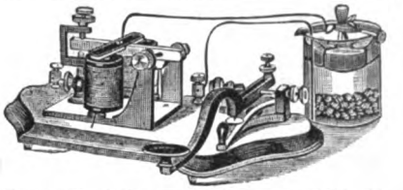

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THE ELECTRIC LIGHT.

A modification of Geissler's tubes has recently been made for the purpose of illumination. It consists of a carbon and vacuum tube, of about one sixteenth of an inch internal diameter, wound in the form of a flattened spiral. The ends of the tube, in which the platinum wires are sealed, are about two inches in length, and half an inch in diameter. They are inclosed in a wooden case, leaving only the spiral exposed. When the discharge from the Ruhmkorff coil is transmitted through the platinum wires, the spiral becomes intensely luminous, exhibiting a brilliant white light. The quantity of light, however, is small, and it is of no practical value. It is only valuable as an experimental apparatus, or for scientific exhibitions.

Electricity of great tension and power is required for the electric light, and the easiest and least expensive mode of getting it for these experiments is by using a large Ruhmkorff coil, but the current from a battery of 200 cells would answer the same purpose. An electric light, without mechanism at the burner, can be made by placing two carbon points in hollow brass rods which are connected by wires with a galvanic battery. The rods slide in the heads of two glass pillars, so fixed to a stand as to admit of the points being placed at different distances. The wires for the battery poles being properly connected, the points are made to touch, and are then just separated, when the most dazzling light appears, rivalling the light of the sun in purity and splendor. The light is due chiefly to the intense whiteness of the tips of the carbon rods, and partly from an arch of flame extending from the one to the other. The positive pole is the brighter and the hotter, a fact which may be proved by intercepting the current, when the positive pole continues to appear red for some time after the negative pole has become dark. Any kind of carbon is well suited for the points. The more compact forms of charcoal answer very well, but baked carbon answers better. This is made as follows: The fine dust of coke and caking coal is put into a close iron mold, of the shape required for the carbon pencils, and exposed to the heat of a furnace. When taken out, the burnt mass is porous and unfit for use; but by repeatedly soaking it in thick syrup or gas tar, and reheating it, it acquires the necessary solidity and conducting power. The best carbon points, both for brilliancy and durability, are made, however, from the coke that is sublimed inside the retorts in the distillation of coal in gas works. During the maintenance of the light, a visible change takes place in the condition of the poles. The positive pole experiences a loss of matter; particles of carbon pass from it to the negative pole, some of them reaching it, and some being burnt by the oxygen of the air on the way. The same occurs, though to a much less extent, with the negative pole; so that, while the positive pole becomes hollowed out or blunt by its losses, the negative pole is kept pointed by the additional particles.

The wasting away, particularly of the positive pole, in a short time renders the distance between the poles too great for the passage of the current, and the light is suddenly extinguished, until again renewed by contact between the carbon points and their separation. If a powerful battery is used, the points may be removed one sixth or even one fifth of an inch before the circuit is broken. The transfer of matter between the poles is considered to account for the existence of the arch of flame, and the passage of the current through the air, as thereby a conducting medium extends between the poles. The light is not caused by the combustion of the carbon, but by its being brought into a state of incandescence. With a battery of fifty Grove or Bunsen cells, a light of very great brilliancy is produced; but when very great power is to be obtained, as well as brilliancy, twice or thrice that number must be employed. Fifty cells give electricity sufficient tension to produce the light; and if more are used, they should be so arranged as to add to its strength and not its tension. Thus, if 150 cells be used, they should be arranged in three series, the positive poles of all three being joined to form one positive pole, and similarly with the negative poles. With a battery of fifty cells it is not necessary to point the rods, as the action of the electricity will do it. A battery of 50 large sized Grove or Bunsen cells will produce a light 34 times the power of the lime ball light, or one fifth as great as that of the sun.

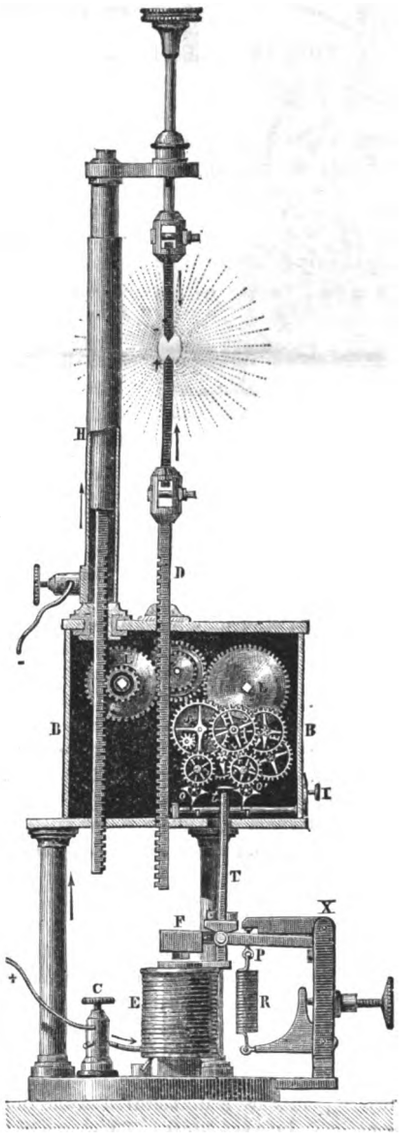

Figure 1.

Various arrangements have been invented for maintaining the steadiness of the electric light. The aim in all such is to keep the carbon points by some mechanical contrivance within such a distance of each other that the current can pass between them. Duboscq constructed an electric lamp of this description. In it, by aid partly of clockwork, the two points were made to travel toward each other at rates corresponding to those of their consumption, the positive pole in this way travelling faster than the negative.

Foucault's form of regulator, Fig. 1, has two systems of wheel work, one for bringing the carbons nearer together, and the other for moving them further apart. Fig. 1 represents the apparatus, with the omission of a few intermediate wheels. L′ is a barrel driven by a spring inclosed within it, and driving several intermediate wheels which transmit its motion to fly, *o*. L is the second barrel, driven by a stronger spring, and driving in like manner the fly, *o′*. The racks which carry the carbons work with toothed wheels attached to the barrel, L′, the wheel for the positive carbon having double the diameter of the other. The current enters at the binding screw, C, traverses the coil of the electromagnet, E, and passes through the wheel work to the rack, D, which carries the positive carbon. From the positive carbon, it passes through the voltaic arc to the negative carbon, and thence, through the support, H, to the binding screw connected with the negative pole of the battery. When the armature, F, descends towards the magnet, the other arm of the lever, F P, is raised, and this movement is resisted by the spiral spring, R, which, however, is not attached to the lever in question, but to the end of any other lever, pressing on its upper side, and moveable about the point, X. The lower side of this lever is curved, so that its point of contact with the first lever changes, giving the spring greater or less leverage according to the strength of the current. In virtue of this arrangement, which is due to Robert Houdin, the armature, instead of being placed in one or the other of two positions, as in the ordinary forms of apparatus, has its position accurately regulated according to the strength of the current. The anchor, T *t*, is rigidly connected with the lever, F. P, and follows its oscillations. If the current becomes

too weak, the head, *t*, moves to the right, stops the fly, *o'*, and releases *o*, which, accordingly, revolves, and the carbons are moved forward. If the current becomes too strong, *o* is stopped, *o'* is released, and the carbons are drawn back. When the anchor, T *t*, is exactly vertical, both flies are arrested, and the carbons remain stationary. The curvature of the lever on which the spring acts being very slight, the oscillations of the armature and anchor are small, and very slight changes in the strength of the current and brilliancy of the light are immediately corrected.

Mr. Hart, of Edinburgh, Scotland, has invented a simple lamp, in which the weight of the rod, in which the carbon is fixed, supplies the place of the clockwork in the above described lamp of Foucault, and an electro-magnet lets it descend, or locks it, as the carbons are consumed.

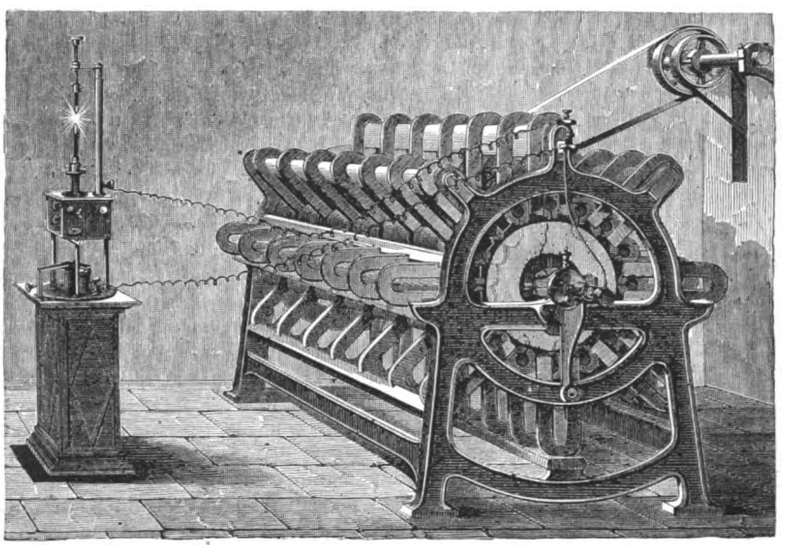

Figure 2.

The attempts which have been made to substitute the electric light for coal gas, in lighting up streets and public places, have hitherto proved unsuccessful. One element of imperfect success, in the practical success of the electric light, is due to the uncertainty of the light and the care attending its use. By contrivances like those we have described, the light may be continued for hours; but even then it is by no means steady, and the apparatus cannot be safely left without an attendant. It has, however, been used with excellent effect where a limited space had to be lighted up for a few nights, as well as for lighthouse illumination. Its power to penetrate fogs is immensely superior to that of oil light. Lighthouses at Dungeness and elsewhere have been lit with electric lights since 1863, the current being obtained from magneto-electric machines driven by steam engines. Fig. 2, represents the machine. It has eight rows of compound horseshoe magnets fixed symetrically round a cast iron frame. They are so arranged that the opposite poles always succeed each other, both in each row and in each circular set. There are seven of these circular sets, with six intervening spaces. Six bronze wheels, mounted on one central axis, revolve in these intervals, the axis being driven by steam power transmitted by a pulley and belt. The speed of rotation is usually 350 revolutions of the axis per minute. Each of the six bronze wheels carries, at its circumference, sixteen coils, corresponding to the number of poles in each circular set. The core of each coil is a cleft tube of soft iron, the form having been found peculiarly favorable to rapid demagnetization. Each core has its magnetism reversed sixteen times in each revolution, by the influence of the sixteen successive pairs of poles between which it passes; and the same number of currents, in alternately opposite directions, are generated in the coils. The coils can be connected in different ways, according as great electro-motive force or small resistance is required. The positive ends are connected with the axis of the machine, which thus serves as the positive electrode; and a concentric cylinder, well insulated from it, is employed at the negative electrode. Two of these machines are provided for each light, though only one is used, except in very foggy weather. These are driven by a six horse power steam engine, and all parts of the machinery, including boilers, are kept in duplicate. Coke is used for fuel, and about 56 lbs. are consumed each night. The machines are connected with the lamps by means of undergrouud cables. Each lamp contains two pieces of carbon, about ten inches long by three-eighths of an inch square. They are made from coke dust, and are consumed at the rate of thirty-four inches per night for each light, at a cost of two cents per inch, exclusive of waste or breakage. They are moved toward each other by means of automatic apparatus; and the only danger of irregularity of the lights arises from the presence of foreign matter in the carbons. This, however, is instantly corrected. The annual cost of the electric light at Dungeness is about $4,000,

The most powerful light which has yet been constructed is that of the flashing electric light at Soutter Point, England, three miles below the mouth of the Tyne, the condensed beam of which is equal to 800,000 candles.

There are two electric lights situated on the South Foreland, three miles from Dover. These are 1,000 feet apart, one being 372 and the other 275 feet above the sea level. . The rear light is utilized, by means of totally reflecting prisms, to reinforce the front light, which is required over a range of 180° only. Both lights are fixed. The power of each beam is estimated as equal to 180,000 candles; and when observed from Dover, a distance of three miles, they throw a very distinct shadow from objects on the pier.

In addition to the above mentioned electric lights, there are in France two fixed lights at La Héve, and a revolving light at Cape Grisnez; in Egypt, a revolving light at Port Said; and in Russia, a fixed light at Odessa. The plan in operation at La Héve is very similar to that of South Foreland. Six-plate magnets, of a power of 145 to 155 lbs., are used, and some three-plate magnets, with the power of 75 lbs. The carbon points are manufactured from the residue contained in gas retorts. They are 10 inches long, and from one-third to one-half an inch thick. The optical apparatus is about e foot in diameter, and it sends the light tangentially to the surface of the sea. Many accidents, however, have occurred at La Héve; in one instance the lights were extinguished for a space of an hour. Much trouble has been experienced with the machinery, which is now placed in a more satisfactory condition. Of the cost of this light, we have no data later than 1869; but it appears that the average of that and the four previous years was $3,215 34, the total number of hours of illumination averaging 4,135 annually. The machines are started 10 minutes before the time of illumination, so that the currents may be well established, and the light is exhibited 15 minutes after sunset, and extinguished 15 minutes before sunrise. Double lights are produced whenever the fog is so dense that the keepers connot see the beacon lights on the north pier at Havre, and this occurs about eighty hours every year.

The disadvantages attending a general use of electricity are due chiefly to the large amount of space required for the steam engines and the magneto-electric machinery, for storing coal, coke, etc., and for collecting and preserving the water for the engines. The repairs needed require also special workmen, not usually found in the vicinity of light-houses. Consequently the electric light can at present be made available only in certain localities. It would be disadvantageous in light-houses at sea, or those which are distant from centres of population. But where there is plenty of space, and where cities are within easy reach, their substitution for other lights is strongly approved by mariners.

On the Depth and Superposition of Magnetized Layers in Steel.—*J. Jamin.*—On December 30, 1872, and later, the author explained certain effects of inverse and direct currents of different intensities upon the same magnet by assuming that the magnetism only penetrates to a limited depth according to the strength of the current, and that the successive actions of the two currents (the first energetic and direct, the second weak and inverse) superpose two contrary magnetizations, the one deep the other superficial. We only perceive the difference, As this conjecture has been contested, the following experiments, apparently of a decisive character were undertaken. Into a steel tube, closed by two steel screw stoppers, was introduced a steel cylinder. The whole was magnetized in a coil by a current whose strength was progressively increased. Whilst weak it acted only on the tube, leaving the cylinder free as before; but with a determined force the cylinder became slightly magnetized, the magnetism increasing with the current strength until it attained the same power as that of the tube. To confirm this, the cylinder was first saturated alone with a direct current, and then introduced into the tube; then the whole concern was submitted (in a coil) to an intense and gradually increasing current. Whilst the current was weak, the cylinder preserved all its magnetism; then, as the current strengthened, the cylinder slowly lost it, afterwards taking another of an inverse nature. There is always a moment in which the whole apparatus possesses no apparent magnetism, and cannot be magnetized by an inverse current, whilst it is energetically magnetized by the direct current which has magnetized the cylinder. But if the cylinder and tube together are thus neutral, it is not in a natural condition; for on separating the two portions, they have different magnetisms—direct on the cylinder, inverse on the tube; they neutralize one another by superposition. This is what takes place in a single piece of steel when submitted to two contrary magnetizations. More direct methods of proof were instituted, consisting in dissolving the exterior parts of the magnets in diluted sulphuric acid. The results M. Jamin considers to be also conclusive, though the carrying out of the experiments was attended with great difficulties.

SUPPLYING A NUMBER OF TELEGRAPH LINES FROM ONE BATTERY.

The method, formerly much in use, of supplying or working a number of telegraph lines from the same battery, depends upon the laws governing the distribution of electricity in branch circuits. We may, for instance, attach to the battery Z K, at the point A (see fig. 1), two separate circuits, the resistances of which, including that of the instrument included in them, are represented by l_1 and l_2. These lines are connected to the earth at E_1 and E_2.

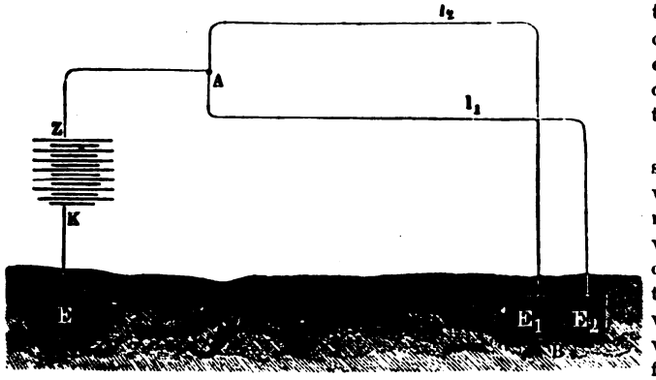

Figure 1.

It is evident that this is in fact, precisely the same arrangement of circuits as that previously considered on page 195 and in fig. 6. The current going out from the point A divides into two branches, which reunite at a common point B (the earth), and the reunited current flows back to E and K, the earth playing the part of a conductor.

If we represent by S the strength of the undivided current in A Z K E B, and by W the resistance of the battery, and the current is supposed to pass simultaneously through both the circuits l_1 and l_2, then,

$$S = \frac{E}{W + \frac{l_1 l_2}{l_1 + l_2}}$$

Now, assuming that the resistance W of the battery in comparison with the sum of the resistances of all the branch conductors,

$$\frac{l_1 l_2}{l_1 + l_2}$$

is infinitely small, then we obtain for the aggregate strength of current in Z A:

$$S = \frac{E}{\frac{l_1 l_1}{l_2 + l_2}} \qquad (a)$$

or,

$$E = S. \frac{l_1 l_2}{l_1 + l_2} \qquad (b)$$

Likewise, upon the same hypothesis, that the battery is closed at the same time through both lines l_1 and l_2, the strength of current S_1 in the branch l_1, will be

$$S_1 = S. \frac{l_2}{l_1 + l_2} \qquad (c)$$

On the other hand, when the current of battery Z K is allowed to pass exclusively through line l_1, then the strength of current s_1, in line l_1, is

$$s_1 = \frac{E}{W + l_1}$$

or, because W in this case = 0,

$$s_1 = \frac{E}{l_1}$$

or, when we substitute the value of E from (b) in the latter equation,

$$s_1 = S \frac{l_1 l_2}{l_1(l_1 + l_2)} = S. \frac{l_2}{l_1 + l_2}$$

therefore, by comparing the latter equation with the equation (c),

$$S_1 = s_1.$$

That is to say, when a number of lines are attached to one common battery, the internal resistance of the latter being infinitely small in comparison with that of the several lines or branch circuits, the strength of current in each circuit will be same as if no other circuit was attached to the battery.

Under such circumstances, when several telegraph lines are connected with one common battery, it is immaterial whether one line alone is worked or whether several lines are operated at the same time. Although this fact may at first sight appear very singular, the explanation is, that while a single line is being supplied from a battery and a second and third line are connected, the total amount of current flowing from the battery divides itself between the three lines, and in consequence of this the proportion of the total current traversing the former circuit becomes smaller than it was previously, but by connecting the two new lines the aggregate sectional area of conductor for discharging the battery increases, and so also does the strength of current in the same proportion, consequently the loss which arises from the division of the current is exactly equalled by the gain resulting from the increased strength of current.

It was upon this principle that formerly a large number of telegraph lines were worked from a single Grove battery. The internal resistance of this battery is so small in proportion to that of a long telegraph line as to be almost inappreciable. For various reasons it has been found preferable to use batteries of greater internal resistance, and work but one or two wires from each one, and this latter arrangement is now generally adopted.

We have already shown that we derive the maximum strength of current from a given battery, when its internal resistance is equal to the resistance of the remainder of the circuit. Hence, when the latter is very great, as in the case of long telegraph lines, the internal resistance of the battery may also be considerable without materially affecting the strength of the current upon the line. For this reason almost all kinds of batteries, even the inconstant ones, are more or less adapted for working telegraph lines, and the longer the line, that is to say, the greater the resistence of the circuit, the better will such batteries answer the purpose. This, however, is the case only when each telegraph line has its separate battery. The result is very different as soon as the same battery is employed to work several lines; for in this case the resistance of the battery becomes an important part of the total resistance and should therefore be limited to the smallest possible amount, for, as we have before stated, each line, whether one or more lines are working, should receive a current of equal strength. It follows from these considerations that the usual practice of increasing the number of elements in a common battery with the number of lines to be worked is entirely wrong, because the total resistance of the battery is increased, and consequently the difference in the strength of current of each single line when closed by itself, or simultaneously with the others, increases also. For this reason inconstant elements (which have considerable resistance on account of the polarization of their plates), or very small elements, are not well adapted for a common or general battery. Assuming that the internal resistance of the battery may be neglected in comparison with the joint resistance of the several branch lines, then each line will, under all circumstances, receive a current of the same strength as if the battery were closed through that line alone. As the number of elements, or the strength of the battery must necessarily be sufficient for the longest line attached to it, the strength of current in the shorter lines, when the difference of length is considerable, will be too great for the instruments in circuit. In order to reduce the strength of the current in the shorter lines to the required amount, we must either insert artificial resistances or else the unequal lines must not all be attached to the same point of the common battery. The shorter lines may preferably be attached to the battery in such a manner, that the number of elements by which it is worked have the same relation to the length of the line as the whole number of elements have to the longest line.

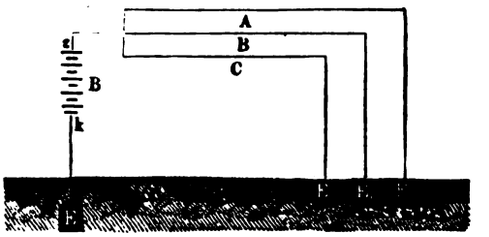

Figure 2.

If we suppose that to a pole z of battery B (fig. 2), whose electromotive force of n elements is $n \times e$ and whose internal resistance is $n \times w$, are attached three lines, whose resistances are indicated by A B C. When the battery is closed by one of these lines, the strength of current, according to Ohm's laws, is:

$$\left.\begin{aligned} \text{for A} \ldots s_1 &= \frac{ne}{nw + A} \\ \text{“ B} \ldots s_2 &= \frac{ne}{nw + B} \\ \text{“ C} \ldots s_3 &= \frac{ne}{nw + C} \end{aligned}\right\} \ldots\ldots (1)$$

If the three lines are closed simultanously, so that the current traverses each line at the same time, the joint resistance of the three lines is

$$\frac{ABC}{AB + BC + AC}$$

and the current strength S in the undivided wire is:

$$S = \frac{ne}{nw + \frac{ABC}{AB + BC + AC}}$$

or

$$S = \frac{ne(AB + BC + AC)}{nw(AB + BC + AC) + ABC}$$

whence the strength of current in each single branch is

$$\left.\begin{aligned} \text{in A} \ldots s' &= \frac{neBC}{nw(AB + BC + AC) + ABC} \\ \text{in B} \ldots s'' &= \frac{neAC}{nw(AB + BC + AC) + ABC} \\ \text{in C} \ldots s''' &= \frac{neAB}{nw(AB + BC + AC) + ABC} \end{aligned}\right\} \ldots (2)$$

If we compare equations (1) and (2) we find the difference of the current strengths in each single line, when the current of the battery traverses the latter alone and the three lines simultaneously. This difference becomes less as w is made less, that is to say, the smaller the resistance of the battery, the less this difference is, and it would disappear entirely if we could make $w = 0$; in this case the strengths of currents given by equations (1) and (2) would be equal, that is, $s_1 = s'$, $s_2 = s''$, $s_3 = s'''$.

If the resistances A B C in the arrangement mentioned herebefore (fig. 2) vary much, the current differences, $s_1 - s'$, $s_2 - s''$, $s_3 - s'''$, which we obtain when a line alone, or when all the lines are closed at the same time, become larger in the respective lines, and as each line requires for the battery only a strength of current proportionate to its resistance, lines differing in resistance, as we have said before, need not be joined to the same pole of the battery. The shorter lines ought rather to be attached to the battery in such a manner that the number of elements which come into operation for the respective line stand in the same relation to the length of the line as the whole number of elements to the longest line.

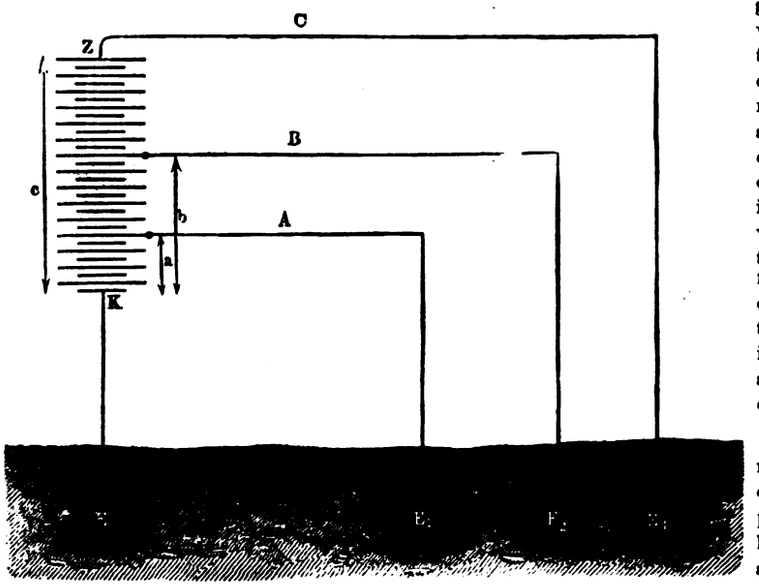

Figure 3.

Hence, when, as in fig. 3, three lines A B C of unequal resistance are to be worked from one battery Z K, the lines should be connected with the battery in such a manner that the relation is

$$\frac{A}{a} = \frac{B}{b} = \frac{C}{c}$$

where, as previously, the resistances of the single lines are indicated by A B C, and the number of elements by a b c, counted from the pole connected with the earth.

Now, if the resistance of an element is w and its electromotive force is e, the strength of current when each line is closed in succession is

$$\left.\begin{aligned} \text{in A} \quad S_1 &= \frac{ea}{wa + A} = \frac{e}{w + \frac{A}{a}} \\ \text{in B} \quad S_2 &= \frac{eb}{wb + B} = \frac{e}{w + \frac{B}{b}} \\ \text{in C} \quad S_3 &= \frac{ec}{wc + C} = \frac{e}{w + \frac{C}{c}} \end{aligned}\right\} \quad \ldots \quad (3)$$

and as the relation of the number of elements in the battery to the resistance of lines is everywhere equal $\left(\frac{A}{a} = \frac{B}{b} = \frac{C}{c}\right)$ there circulates, relatively considered, an equally strong current in each line. When we may assume that the resistance of the battery and that of the earth are equal to nought, the strength of current in each line closed separately is no greater than it would be where all three lines closed simultaneously.

It follows from these considerations that a battery which serves to work several lines should have its internal resistance made as small as possible, and that the separate lines in the order of their respective resistances should be connected with a proportionate number of elements, so as to limit the differences of currents to so small an amount that they may be neglected in practice.

It remains to be mentioned that on lines subject to heavy escapes the use of one battery to supply several circuits has frequently proved unsuccessful and has given rise to erroneous opinions. In consequence of the escapes by partial ground connection, the joint resistance of the several circuits becomes greatly reduced, and when a line on which there is considerable escape in proportion to its resistance, is attached to a battery supplying other wires, the proportion of the division of current is disturbed in these wires, especially when the resistance of the affected wire is small. The difference of current in the good wires will vary in the same proportion as the escapes on the bad one.

When all the wires are not affected with escapes of nearly equal value in proportion to their length, the poorly insulated ones should be worked by separate batteries.

It has already been shown that where several lines are worked from one battery, the strength of current in each line may also be brought nearly to correspond with its resistance by inserting artificial resistances, and attaching the different lines to the same pole of the battery.

Suppose in fig. 4 from point B, which is attached to the zinc pole of the battery Z K, of the central station A, five lines branches off to stations S_1, S_2, S_3, S_4 and S_5. Let n be the number of elements in the battery; w the resistance of a single element, e its electromotive force. and r the resistance of the wire A B; also let l_1, l_2, l_3, l_4 and l_5 represent the respective resistances of the derived circuits branching off from B, including as well the resistance of the instrument in circuit.

We, therefore, have for the joint resistance of the branch line from B:

$$Z = \frac{l_1 l_2 l_3 l_4 l_5}{l_1 l_2 l_3 l_4 + l_1 l_2 l_3 l_5 + l_1 l_2 l_4 l_5 + l_1 l_3 l_4 l_5 + l_2 l_3 l_4 l_5}$$

and hence the total resistance W of the entire circuit of the battery

$$W = n\,w + r + Z,$$

and the strength S of the current in the undivided wire A B,

$$S = \frac{ne}{W} = \frac{ne}{n\,w + r + Z}$$

Upon the same principle we obtain for the strengths s_1, s_2, s_3, s_4, s_5, of the currents traversing the different lines to the stations S_1, S_2, S_3, S_4, and S_5.

$$s_1 = S.\ \frac{l_2 l_3 l_4 l_5}{l_1 l_2 l_3 l_4 + l_1 l_2 l_3 l_5 + l_1 l_2 l_4 l_5 + l_1 l_3 l_4 l_5 + l_2 l_3 l_4 l_5}$$

$$s_2 = S.\ \frac{l_1 l_3 l_4 l_5}{l_1 l_2 l_3 l_4 + l_1 l_2 l_3 l_5 + l_1 l_2 l_4 l_5 + l_1 l_3 l_4 l_5 + l_2 l_3 l_4 l_5}$$

and in like manner we may ascertain the values for l_3, l_4, and l_5.

We at once see that the strengths of currents in the different lines are not equal, and that, in order to make them so, artificial resistances must be placed in the shorter circuits. As the main current at B divides itself in five branch currents, and as these currents are to have the same strength (it being assumed that the instruments at each station have the same resistance), the artificial resistance for each station must be of such an amount that by its addition the resistances l_1 . . . . l_5 become equal to each other, when it is obvious that

$$s_1 = s_2 = s_3 = s_4 = s_5.$$

The longest line, for instance, S_5, does not need any additional resistance. If we indicate the resistance of the instruments by a, the artificial resistances to be inserted at S_1 . . . S_4 by x_1 . . . x_4 the resistances of the sections BS_1, BS_2, . . etc., less the resistance of the apparatus by L_1, L_2, etc., then,

$$\begin{aligned} & l_1 = l_2 = l_3 = l_4 = l_5 \\ \text{as} \quad & l_1 = L_1 + a + x_1 \\ & l_2 = L_2 + a + x_2 \\ & l_3 = L_3 + a + x_3 \\ & l_4 = L_4 + a + x_4 \\ & l_5 = L_5 + a \end{aligned}$$

From which we may easily calculate the artificial to be inserted at each station, namely,

$$x_1 = L_5 - L_1\ ;\quad x_2 = L_5 - L_2\ ;$$

and in like manner for the others.

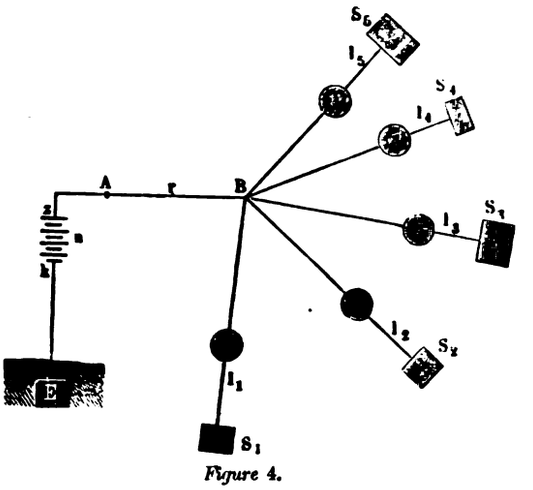

Figure 4.

The remaining formulæ for the resistance Z of the branch lines, as well as for that of the whole resistance W of the circuit then become

$$Z = \frac{l_5}{5}; \quad \text{and} \quad W = n\,.\,w + n + \frac{l_5}{5}.$$

By substituting the values the above expression, we obtain for S:

$$S = \frac{ne}{n\,w + r + \frac{l_5}{5}} \quad \ldots \quad (1)$$

also,

$$s_1 = s_2 = s_3 = s_4 = s_5 = \frac{S}{5},$$

or,

$$s_1 = s_2 = s_3 = s_4 = s_5 = \frac{n\,e}{5\,(n\,w + r) + l_5} \quad . \quad (2)$$

Now, in order to determine how many elements should be used to work the instruments in the branch circuits, when the currents are alike in all, we must find by observation, what strength of current, under certain conditions, is required to work them. For instance, we know that under ordinary circumstances, a Daniell's battery of 40 elements is sufficient to work a rely of 150 Ohms on a line of 1,500 Ohms' resistance. The strength S, of such a current, when e and w retain their former value, is

$$S_1 = \frac{40\,.\,e}{40\,.\,w + 1{,}650}$$

If now we call the resistance of a Daniell's element two ohms, the current required to work the instrument is,

$$S_1 = \frac{e}{43.25} \quad . \quad . \quad . \quad . \quad . \quad . \quad (3)$$

Adopting this value of S as the strengfh of current required in each of the five circuits S_1, S_2, S_3, S_4, S_5, we obtain from the equations (2) and (3):

$$\frac{n\,e}{5\,(n\,w + r) + l_5} = \frac{e}{43.25}$$

hence,

$$n\,(43.25 - 5\,w) = 5\,r + l_5$$

or, when $w = 2$ Ohms,

$$n = \frac{5\,r + l_5}{33\ 25} \quad . \quad . \quad . \quad . \quad . \quad (4)$$

Now, suppose the resistance of the line A B is 500 ohms, and the line B S_5, 1,000 ohms, then, as the resistance of the instrument is 150 ohms, we have,

$$r = 560,$$
$$l_5 = 1{,}150;$$

by substituting these value in equation (4) we finally obtain,

$$n = \frac{5 \times 500 + 1{,}150}{33.25} = 109.77,$$

or, in round numbers,

$$n = 110.$$

Whence it follows, when we have made the resistances l_1 . . . l_5, equal to each other by inserting resistances at the different stations, and each is equal to $l_5 = 1{,}150$ Ohms; that a battery of 110 Daniell's elements at station A will supply simultaneously to each of the lines B S_1 . . . . B S_5 currents of equal strength; each of which is strong enough to work the relays in the respective circuits.

ANGLO-AMERICAN TELEGRAPH.

The following are the traffic receipts of this company from messages at the reduced tariff of 2s. per word for the week ending on June 25:

Friday	June	19	£1,500
Saturday	"	20	1,340
Sunday	"	21	350
Monday	"	22	1,250
Tuesday	"	23	1,460
Wednesday	"	24	1,540
Thursday	"	25	1,350

The average daily receipts in June last year, with the messages at the rate of 4s. per word, was £1,959.

THE GALVANIC BATTERY.

In respect to the economical application of electricity, no subject is so important as the relative merits of different forms of batteries. For illuminating purposes and lecture demonstrations we have hitherto had to rely upon the Bunsen or Grove battery; but, during the siege of Paris, a form of bichromate of potash battery, known as the Chutaux battery, was frequently employed to yield the electric light used on the ramparts. Count Moncel gives a full account of the different forms of the Chutaux battery, and furnishes some interesting data for the comparison of the Chutaux and Bunsen battery when giving the electric light. The following results were obtained from the two batteries, each being composed of 48 cells, and each working for two hours:

BUNSEN'S BATTERY.

Light equal to At beginning.	End.	Mean.	Surface of zinc employed.
109	66	87.5	318-61 square inches.

Carcel lamps.

CHUTAUX BATTERY.

Light equal to At beginning.	End.	Mean.	Surface of zinc employed.
132	63	97.5	92.88 square inches.

In working each of these batteries for half an hour successively, the following results were found:

	Bunsen. Light equal to	Chutaux. Light equal to
1st period of half an hour....	109 Carcel lamps.	132 lamps.
2d period of half an hour. Beginning	134 lamps.	128 "
2d period of half an hour. End	137 "	100 "
3d period of half an hour.. Beginning	106 "	80 "
3d period of half an hour.. End	97 "	51 "
4th period of half an hour.....	End 66 "	63 "

According to these figures the bichromate of potash battery flags much quicker than the nitric acid battery, a fact which evidently depends on the polarization of its plates, to which it is always liable. It is, however, more economical.

One rather important advantage of these batteries is that they can kept in a closed place without giving out any odor or unhealthy emanation; besides this, the liquid evaporates slowly. The author had also been able to verify the statement that, after a battery had been charged for more than a year, and then left alone, it had hardly lost anything of its power. The relative consumption of zinc and acid and the comparative cost of working of the whole battery are not given; but so far as the foregoing data are concerned, the Chutaux evidently promises extremely well. So says the *Telegraphic Journal*. For lecture purposes an electric light is rarely wanted for more than half an hour, the great desideratum being a rapid means of charging and discharging the battery. In this respect nothing could be better than the Chutaux; being a single fluid battery, the plates can be raised and lowered easily and rapidly. One of the characteristics of this bichromate battery is the constant percolation of fresh solution through the battery; by this means a good deal of the bad effect of polarization is got rid of. Here is the composition of the solution of his batteries, recommended by M. Chutaux; Water, 1,500 grains; bichromate of potash, 100 grains; bisulphate of mercury, 50 grains; sulphuric acid, 200 grains. The electromotive force of such a cell is at first more than twice that of a Daniell cell, but in duration it cannot, of course, be favorably compared.

The cost of working the Chutaux, Count du Moncel finds to be about 35 cents, which he states is less than that of a Daniell cell, the advantage being that in the Chutaux an electro-motive force of nearly double is obtained, and an internal resistance less than half that of the Daniell, besides other obvious advantages noticeable in the working of the two forms. A battery of 24 Chutaux cells, according to our author, can furnish a rarely brilliant electric light at a cost of about 15 cents per hour.

SAVED BY LIGHTNING.

Since it appears tolerably evident that a St. Louis scientist has hit the nail on the head in his weather prognostications for the Summer of 1875, and that there will be wind-storms and rain-storms in abundance, we may settle down to the probable conviction that it will not be a cholera season in this country. This, of course, if the sanitary condition of cities is kept anything near what it should be. Electricity in the air appears to be bad for the cholera germs, and *apropos* of this fact, may be related a little incident, true in every particular, and never yet in print. During the great cholera season of 1849, a man living in Mooretown, Canada—a small place opposite St. Clair, on the American side of the St. Clair River—was one of the victims of the plague. He was taken sick with cholera, suffered terribly, and finally, as was supposed, died. The body was prepared for the grave, and laid out upon bed, awaiting a coffin and funeral ceremonies. In the interval a violent thunder storm came up suddenly, the shocks were terrific and followed each other in rapid succession. At length came a blinding flash, followed by a deafening peal of thunder, and the house in which the body of the victim of cholera lay was struck by lightning, the body itself apparently receiving a portion of the electric charge. What followed was most astonishing. The supposed dead man showed signs of life. Ever attention was paid him, all possible medical assistance afforded, and the final result was that he recovered. He still lives in Mooretown, and the statements of this incident can be readily substantiated. The hero of this affair is perhaps the only man existing who can say that he owes his being to a stroke of lightning. Electricity saved his life as it is said to have saved the lives of drowned men. There may be a hint in the affair for the physicians. There is evidently no sympathy between cholera and lightning. —*St. Louis Republican.*

ELECTRIC CONDUCTIVITY OF CARBON.

At a recent meeting of the London Physical Society, Mr Bauerman, F. G. S., described and illustrated a very simple method for ascertaining the electric conductivity of various forms of carbon. The method, which was originally devised by Dr. von Kobell, consists in holding a fragment of the substance to be tested with a strip of zinc bent in a U-form, and immersing it in a solution of copper sulphate. In the case of a bad conductor, a deposit of copper takes place solely on the surface of the zinc, but when a good conductor is employed, a zinc carbon couple is formed, and a deposit takes place on the surface of the carbon. Numerous specimens were exhibited which showed that the conducting power is greatest in coal which has been subjected to a great degree of heat, and the lowest temperature at which this change takes place, appears, in the case of anthracite, to be between the melting points of zinc and silver. Such experiments appear to be specially important as giving a clue to the temperature at which anthracite metamorphism has been effected by the intrusion of igneous rock.

On the Magnetizing Function of Tempered Steel. —*M. Bouty.*—The magnetic movement of a needle may always be considered the product of two factors, one of which expresses the quantity of magnetism in the needle, or, if preferred, the strength of each pole whilst the other factor is equal to the distance of the two poles. The determination separately of these two distinct elements, and the study of the variation of each of them under changed magnetizing conditions, occupied by Mr. Bouty some time, and his investigations are still incomplete.

TARIFF BUREAU.

SEMI-MONTHLY CIRCULAR.

EXECUTIVE OFFICE,
WESTERN UNION TELEGRAPH COMPANY,
Broadway, cor. Dey street, New York, July 15, 1875.

To all offices in W. U. Lines:

The following changes and additions have been made since the date of the last circular:

GENERAL INFORMATION.

Bellevue, Ala., closed.

Aptos, Cala., reopened.

Los Banos, Cala., closed.

Hereafter the "tariff for other lines" from Visalia to Kingston, Cala,, will be 60-30 instead of 30-10, as at present.

The P. O. A. of Niwot, Col. is Modoc P. O.

Forks of Clear Creek, Col., reopened.

New Chicago, Ks., changed to Chanute.

Messages taken for Farmingdale and Pittston, Me., are delivered from Gardiner, Me. Charges for delivery 25 cents per message to each.

In messages for Mexico, addressed to one party in care of another, only the name of the first and the name of the office are sent free, all other words in the address are to be charged for—for example:

Jose Maria Garcia.
Care of Dr. Pedro Garcia,
Calle Numero 24,
Mexico City.

The words "*Care of Dr. Pedro Garcia, CalleNumero* 24," are counted as 9 extra words.

Oak Bluffs, Mass., is now a W. U. Office, tariff, 25 cents more than Wood's Hole, check direct.

Carp River, Mich., closed.

The new office given as Pittabawassa, Mich,, in last JOURNAL, should read Tittabawassa.

Morton, Miss., closed.

Winchester, Miss., closed.

Keytesville, Mo., reopened, square, 418.

Offices are hereby notified that half rate messages should not be taken for any office in, or east of New Brunswick and Nova Scotia, whether on "this line" or "other lines," except St. John, N. B., and Halifax, N. S.

Messages taken for Beach Haven, N, J., during the summer season are delivered from Tuckerton, N. J., without extra charge for delivery.

Guymard, N. Y., reopened as a W. U. office, square 46.

Fremont, N, C., closed.

Halifax, N. C., closed.

In JOURNAL of June 15th, 1875, the name of Carroll, Ottawa, Co., O., Office, was changed incorrectly to La Carue. It should have read La Carne.

Business for Hatfield, Pa., will hereafter be checked direct.

Harbor Creek, Pa., closed.

Hopbottom, Pa., changed to Foster.

Sarvers, Pa., closed.

SUMMER OFFICES REOPENED.

Lebanon Springs, N. Y.
Cresson Springs, Pa.
Watch Hill, R. I.
Bon Aqua Station, Tenn,
Bath Alum Springs, Va.
Healing Springs, Va.
Hot Springs, Va,
Montgomery White Sulphur Springs, Va.
Yellow Sulphur Springs, Va.
Warm Springs, Va.

The office at Jordan Alum Springs, Va,, will not be reopened this season, business should be sent and checked to Rockbridge Alum Springs, from which office messages are delivered.

NEW OFFICES.

304 Brown's Station, Ala.
294 Saluria, Ala.
* Conway, Ark. 30 2 from Little Rock.
* Morrilton, Ark. 40 3 " "
* Russellville, " 40 3 " "
296 Danforth, Ill.
337 Stonington, Ill.
* Coushatta, La., 50 4 from Minden.
16 Philips, Me,
16 Strong, Me.
513 Steele City, Neb.
192 Albany, Athens Co., O., P. O., Lee.
* Cheapside, Ont.
* Fournier, "
* Pendleton. Ont.
* St. Helens, "
* Thamesford,"
58 Foster, Pa., (formerly Hopbottom.)
59 Hartsville, Pa.
59 Telford, Pa.
* Bergerville, Que.
* Caconna Sta., J. C. R. R. Que.
192 Hartford City, W. Va., check Pomeroy, O.
192 Mason City, W. Va., Check Pomeroy. O.

WILLIAM ORTON,
President.

TRANSFER SERVICE.

EXECUTIVE OFFICE,
NEW YORK, July 9, 1875.

The name of the money order office heretofore known as Ausable, Michigan. has been changed to Oscoda, Michigan.

Portsmouth, O., has been discontinued as a money order office.

GEO. H. MUMFORD.
Vice-President.

THE TELEGRAPHERS' MUTUAL BENEFIT ASSOCIATION.

RECEIPT OF ASSESSMENTS.

NEW YORK, July 10, 1875.

ASSESSMENT No. 76.

13, 19, 21, 26, 31, 51 61, 70, 75, 80, 84, 89, 93, 97, 112, 114, 120, 129, 134, 154, 156, 158, 160, 164, 171, 206, 218, 227, 232, 240, 244, 245, 248, 252, 257, 274, 278, 279, 281, 282, 283, 285, 316, 319, 341, 342, 350, 353, 356, 357, 360, 361, 362, 364, 366, 378, 380, 382, 405, 406. 411, 412, 413, 425, 456, 463, 478, 481, 482, 484, 511, 512, 527, 533, 545, 548, 566, 569, 573, 574, 577, 579, 584, 590, 594, 600, 618, 648, 662, 663, 664, 665, 669, 672, 678, 680, 694, 712, 723, 724, 725, 728, 730, 733, 769, 772, 780, 787, 791, 803, 813, 815, 821, 823, 832, 848, 869, 870, 876, 897, 899, 904, 905, 920, 927, 929, 931, 932, 934, 938, 939, 942, 949, 954, 957, 959, 963, 964, 978, 979, 992, 995, 1011, 1028, 1030, 1031, 1033, 1034, 1046, 1050, 1055, 1057, 1058, 1063, 1069, 1072, 1080, 1100, 1101, 1105, 1106, 1107, 1108, 1109, 1110, 1112, 1113, 1115, 1117, 1119, 1120, 1122, 1123, 1125, 1131, 1148, 1149, 1152, 1153, 1167, 1190, 1191, 1205, 1211, 1217, 1232, 1234, 1237, 1238, 1241, 1248, 1251, 1268, 1269, 1270, 1274, 1288, 1290, 1294, 1307, 1309, 1311, 1312, 1313, 1314, 1315, 1317, 1318, 1319, 1320, 1321, 1322, 1329, 1353, 1354, 1355, 1356, 1358, 1372, 1376, 1398, 1406, 1412, 1415, 1421, 1428, 1438, 1453, 1454, 1455, 1456, 1457, 1458, 1482, 1483, 1485, 1497, 1500, 1506, 1507, 1515, 1516, 1538, 1529, 1530, 1537, 1542, 1546, 1550, 1559, 1564, 1576, 1580, 1590, 1596, 1597, 1600, 1605, 1607, 1608, 1610, 1611, 1612, 1625, 1634, 1639, 1652, 1658, 1660, 1661, 1662, 1663, 1665, 1667, 1676, 1690, 1691, 1692, 1696, 1697, 1698, 1714, 1728, 1732, 1733, 1750, 1751, 1753, 1754, 1755, 1756, 1757, 1758, 1759, 1760, 1765, 1766, 1767, 1769, 1771, 1789, 1795, 1796, 1797, 1802, 1804, 1813, 1817, 1818, 1823, 1824, 1831, 1835, 1837, 1838, 1844, 1845, 1857, 1858, 1859, 1860, 1863, 1874, 1877, 1881, 1889, 1895, 1911, 1913, 1914, 1934, 1943, 1958, 1973, 1978, 1992, 1993, 1995, 1999, 2001, 2004, 2007, 2010, 2012, 2022, 2028, 2035, 2038, 2053, 2065, 2084, 2092, 2095, 2108, 2110, 2112, 2119, 2123, 2125, 2131, 2137, 2143, 2145, 2156, 2157, 2167, 2171, 2174, 2187, 2195, 2211, 2220, 2223, 2224, 2225, 2226, 2230, 2231, 2238, 2244, 2245, 2246, 2262, 2267, 2268, 2271, 2272, 2291, 2292, 2300, 2301, 2303, 2307, 2312, 2318, 2321, 2324, 2327, 2340, 2346, 2350, 2357, 2361, 2366, 2368, 2369, 2374, 2382, 2397, 2399, 2401, 2415, 2422, 2423, 2429.

ASSESSMENT No. 75.

27, 98, 237, 238, 242, 246, 258, 451, 453, 455, 457, 804, 871, 908, 1715, 1716, 1718, 1731, 1786, 1941, 1974, 1976 2000, 2037, 2120, 2177, 2266, 2320, 2323, 2328, 2353.

Members of the Association who look to the JOURNAL OF THE TELEGRAPH for receipt of assessments paid, will please take notice that an acknowledgement of the receipt of one assessment should be taken as a receipt for all previous assessments.

A TELEGRAPHER MURDERED.

MR. JOHN TREVOR, of Rochester, N. Y., for some years station repairer for the Western Union Telegraph Company, but of late acting as watchman for one of the banks of that city, was on Friday night, July 2d, shot by a burglar he was endeavoring to arrest. He has since died leaving a wife and small family. His death has created a widespread sympathy in the community where he was well known and esteemed. He was a member of the Telegraphers Mutual Benefit Association.

NEW TELEGRAPH ENTERPRISE.

From the Chicago Tribune.

SAN FRANCISCO, July 7.—There has been incorporated here to-day an association of our principal capitalists under the name of the National Telegraph Company, for the purpose of, as stated in their articles of incorporation, "the construction, conduct and maintenance of telegraph lines between the cities of New York and San Francisco, and between said cities and all other principal cities and towns in the United States and to the Territories thereof, and in the Dominion of Canada, and to connect by said telegraph lines said principal cities and towns with each other." The estimated length of the line is 75,000 miles. The capital is $25,000,000, of which is $7,500,000 has been subscribed, and 10 per cent. already paid in. The names of the first Board of Directors are Michael Reese, Calvin W. Kellogg, John B. Keene, Faxon D. Atherton, William Sharon, the new United States Senator from Nevada, William Burling, and Alfred A. Cohen. Thsse gentlemen are among our heaviest moneyed men, and their aggregate belongings is certainly not less than from $40,000,000 to $50,000,000.

THE MAGNETIC CURVES.

Rev. G. H. Hopkins gives the following method for fixing the curves which steel filings take when under the action of a bar magnet. The filings having been prepared so as to be as nearly the same size as possible, and that size very minute, are poured into a mortar, and a small quantity of finely-powdered resin is added; these are stirred together until the two substances are completely mixed, and then, considerable pressure being exerted upon the pestle, they are rubbed until the resin adheres to the filings in a very fine coating. The filings can then be sprinkled as usual, and the curves formed. It is best (after the curves are formed) to heat the surface (glass, paper, or wood, according to convenience) over a stove or in an oven, which easily allows it to be sufficiently as well as uniformly heated. For projecting the curves on a screen, the following, we believe, is a very effective method:

Cover the glass with thin gum water, allow it to dry perfectly: obtain the curves on dry gummed surface; finally; breathe on the plate; the gum is thereby softened, and the curve permanently fixed. Substituting correspondingly shaped pieces of paper for the magnets (a pinhole can be used to indicate the north pole, the curves can be covered with a second plate of glass, and thus preserved as an ordinary lantern slide.

MAGNETS FOR ELECTRO-MOTORS.

Magnets or armatures for electro-motors may be softened as follows: Heat the iron to an even, dull red heat all over; and if the surface of the iron has not been faced off in a machine, lightly file it to remove the scale, and then immerse it in common soft soap, allowing it to remain therein until it is quite cold. Then reheat the magnet to an even, red heat, whose redness is barely perceptible, and bury it in pulverized lime, wherein it must also remain until it is quite cold, when the metal will be found as soft as it is possible to make it, and the blade of an ordinary knife will cut it. At the second heating, the iron will emit a light blue flame, showing the effect of the immersion in the soft soap. The conductibility of the magnet may be, by this proeess, very much increased.

The telegraph line between Tampico and San Luis Potosi, Mexico, has been completed.

THE SERVICE.

WESTERN UNION TELEGRAPH COMPANY.

MAY 1875.

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F. P. Ross, " "
G. Swift, " "
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J. Hersberg, Johnson's Pool Room.
C. Cadiz, Merchant's Hotel.
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J. H. Kennedy, 6th ave 42d st.
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C. H. Alden, Duxbury, "
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Leon McMahon, Galveston, Tex.
A. Blucas, Forest City, Ark.
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A. A. Honey, Salt Lake, Utah.
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A. Robinson, Marshall, "
Jno. McKinney, Otsego, "
R. B. Beckwith, Plainwell, "

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H. J. Mosier,	St. Nicholas "	520 Hudson st.
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W. G. McGowan,	516 Broadway,	689 Broadway.
W. A. Redfield,	5th Avenue Hotel,	St. Nicholas Hotel.
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DISCOVERIES.

Discoveries in Science are the result either of experiment, of thought, or of chance. An experimental discovery is usually the result of a well-planned attack upon some fortress of Dame Nature—every step, every sap, and every battery being well considered and faithfully followed; or it results from the attacking force perceiving indications of some sunken mine, or unknown treasure, and following it up with care and determination. Davy's discovery of the safety lamp is an example of the first kind. Something was wanted—its requirements were well defined; Nature was asked to supply those wants and requirements, and she was forced, by experiment and inquiry, to reply. Faraday's discovery of magneto-electricity was of the second kind. He was engaged in solving a difficult and intricate problem; something attracted his attention, he followed it up, traced it out, and was rewarded with the discovery of what ought to be universally called *Faradaism*.

A discovery, the result of pure thought, must be based on experience. An experiment sets

—"That inward eye
That is the bliss of solitude"

a-working. The imagination is brought into play. Thought pictures something that should be, and observation finds out that it is. Graham's discovery of dialysis, and of the occulsion of hydrogen by iron, was of this character. So have been the innumerable additions made to organic chemistry by Liebig and his followers. So have been the strides made in the theory of energy by Mayer, Joule, Thomson, Clausius, and others. Experiment has set the ball rolling, thought has kept it going, and imagination has said: "If I only direct it in such a path I am sure to alight on some treasure, or it is sure to bring me to the goal I seek."

Discoveries cannot be said to be the simple result of pure chance. Newton and the apple are said to have led to the discovery of gravitation; but the apple was only the means to direct the thoughts of the philosopher in a certain channel, which certainly led to success; but he had been previously pondering and weighing innumerable other channels and courses. Galvani and the frog are said to have led to the chance discovery of voltaic electricity, but the frog may have jerked its legs on the professor's balcony, or skipped into the physicists laboratory with the energy of a ballet dancer, before it would have led to the discovery of current electricity, unless there had been a trained mind to watch its antics, to follow up its peculiarities, and to ferret out its indications.

Daguerre's discovery of the influence of the vapor of mercury upon sensitive plates of silver is another which is included among chance discoveries. He had been experimenting on silver plates rendered sensitive by iodine, and had, after exposure, put them in a cupboard full of chemicals. To his surprise he found, after a time, pictures develop themselves on the plates, attributing the effect to some chemical. He removed the chemicals, one by one, until all had been removed. The effect, however, continued. He then found an unknown and forgotten flask of mercury, which gave out its vapor, and thus produced the effect observed—and this was the origin of the daguerreotype process. But this was not purely the result of chance. It was the previous training and previous experience which arranged the conditions that lead to the discovery, and which enabled the mind to seize upon those very facts which resulted in success. Training and experience are, therefore, essential in seizing upon abnormal indications of Nature, as they are in comprehending and appreciating their laws, and applying them effectively to practice.—*Telegraphic Journal.*

PHOTO-ELECTROTYPE PLATES.

MR. WALTER WOODBURY proceeds as follows to make electrotype plates by a photographic process: a plate of metal is coated with gum, glucose and bichromate of ammonia, dried rapidly and exposed under a positive to the light. When the plate is breathed upon it will be found to have different degrees of stickiness, so that when emery or pulverized glass is dusted over it, commencing with a coarse powder and continuing with powder one or two numbers finer, it will found that the coarser particles adhere readily to the most sticky portions, and the finer to the other portions. Then, when the plate has been hardened by a subsequent exposure to the light, it can be used as a mold for obtaining an impression in soft metal, which can be electrotyped.

ACTION OF THE ELECTRIC CURRENT ON FUSED METALS.—The behavior of amalgams and melted alloys, when traversed by the galvanic current, was studied a few years ago by M. Gerardin, who, however, did not make quantitative measurements. We find from *Archives des Sciences* that M. Obach has lately gone into the matter more fully, and arrived at somewhat different results. His conclusions are:

1. The passage of the galvanic current does not produce any electrolysis, either in amalgams or in alloys.

2. After having been traversed by a current, amalgam decomposes equally water at both poles exactly as before.

3. The action of the current does not at all modify the hardness or the malleability of the alloy lead tin, nor the state of fluidity of the alloy potassium sodium.

It does not produce in the composition of the alloy, in the neighborhood of the electrode, any change exceeding the limits of possible error in the analysis.

Journal of the Telegraph.

This Journal is issued on the 1st and 15th of each month. Its circulation is over 8,000, It goes to every State, Territory and Province on the Continent. It has become a necessity, and is always welcomed as a friend. No better medium for advertising exists.

TERMS:

TWO DOLLARS PER ANNUM IN ADVANCE.

Address—

JOURNAL OF THE TELEGRAPH,
Western Union Telegraph Company.
195 Broadway, New York.

NEW YORK, JULY 15, 1875.

THE COMBINED ENVELOPE AND BLANK.

We have received a communication from Mr. Thomas Orton, of Chicago, drawn forth by the allusion in the JOURNAL of June 15th, to a combined envelope and blank for telegraphic use, recently patented by Messrs. Gross and Kelchner, of Springfield, Ill. Mr. Orton takes the same view of the subject as the JOURNAL, that it is from experience only that the value of such contrivances can be determined, and presents various reasons showing their doubtful utility. Mr. Orton, who has had much experience in the service and who has given this particular subject much thought, sends us specimens of a combined blank and envelope which he claims is better adapted to the purpose and which he devised two years ago.

There seems to be but one advantage in the combination, and that, at best, is doubtful. It is in the time saved in addressing the envelope which, as at present, covers the message. This is more than counterbalanced by the incompleteness of the message on its face and the complicated character of the blank.

THE regular quarterly dividend of the Western Union Telegraph Company, two per cent., declared June 9th, is payable at the office of the Treasurer of the Company, Western Union Telegraph Building, on and after July 15th. The transfer books are closed until July 16th.

THE Western Union Telegraph Company is now prepared to pay the principal and accrued interest of its bonds, maturing November 1st, 1875, upon delivery of the bonds at the office of the Treasurer.

AN unexpected demand for the issue of June 1st, 1875, has completely exhausted our supply of the JOURNAL of that date. Our supply of the JOURNAL of February 15th, is also very low. Superintendents and others who may have surplus copies will confer a favor by returning them to this office.

LATEST FROM THE NEW CABLE.

We have a report from London that the Allan steamship "Prussian," on her voyage from Quebec to Liverpool, passed the "Faraday" on the first day of July. The "Faraday" appeared either to have the new cable on board, or to be grappling for it. As more than two weeks have elapsed since she was seen, the presumption is that she had not succeeded in getting the cable on board, as in that event it would have been practicable to communicate through the cable, which has not yet been done.

The fact is not generally known that the core of the new cable is made on a different plan from all other submarine cables. The standard core is composed of seven strands of copper wire wound spirally upon each other; so that, in the event of a considerable strain upon the cable, the conductors will stretch without parting. The core of the new cable, however, is made of one large copper conductor, with a few very small copper wires wound spirally around it. As this cable has been broken, lost, picked up, spliced, and broken and lost again some six or eight different times, it is probable that in grappling for it, and lifting it—in one instance through water more than two miles deep—the straight, unyielding central copper wire of the core must have been parted in many places, and the "fault"—developed after the laying was completed, and connection between Ireland and Rye Beach was established, and which the "Faraday" is now seeking to repair in water about two miles deep,—was really the parting of the main core. Even if this particular fault is repaired, we apprehend that others of like character will speedily develop, and that in the effort to repair them new ruptures will occur from the straining of the core when the cable is to be lifted through water of great depth.

In short, this enterprise, whose inauguration and progress has been attended by an extraordinary array of wind instruments, seems liable to prove not merely a failure, but discreditable to all concerned.

The operating room of the Central Office of the Western Union Telegraph Company we have already fully described in these pages, and it is, unquestionably, the finest room of the kind on the continent. Recently some fine photographs have been taken of this spacious apartment by a skillful artist, and have been placed in the hands of Mr. Wm. Holmes, Secretary of the Telegraphers' Mutual Benefit Association, to be sold for the benefit of that institution, and who will transmit copies to all who desire them.

The photographs are four in number,

1. Large photograph 10x14.....$1 75.
2. Same, 8x10..... 1 00.
3. Stereoscopic views..... 50.
4. Photograph of the Switch..... 1 00.

On receipt of the amount Mr. Holmes will mail, postage paid, either of these photographs to any party applying for them. A profit is possible only by a large sale.

IMPROVEMENTS.

General Superintendent Van Horne is doing excellent service in putting in first rate working order those portions of the lines in the Eastern Division which the fortunate changes of last winter added to the Southern Division. As an illustration of the benefits which are accruing under his supervision we may mention that he has very materially reduced the resistance of some of these wires by soldering the joints, in one case, from twenty to eighteen ohms per mile; in another, from twenty-four to eighteen ohms per mile; and in another from forty-two to sixteen ohms per mile.

It is unnecessary to comment upon the value of work of this description. The first requisite for successfully handling the traffic is good working lines. The first requisite for good working lines is good conductivity. The best way to get this is by soldering the joints. Under the present vigorous treatment the wires between New York and Washington will soon compare favorably with those of the other sections of the Company's system, a result which will be largely appreciated.

THE NEW CABLE TO MARTHA'S VINEYARD.

The Western Union Cable, connecting Martha's Vineyard with the mainland, was successfully laid on Thursday, 8th instant, from the schooner D. L. Sturgis, in tow of the revenue cutter Gallatin. The cable is one inch in diameter and was made in England. It is working finely, and the Vineyard people are congratulating themselves at no longer being telegraphically isolated from the rest of the world.

The origination of this enterprise is mainly due to Superintendent C. F. Wood, who personally and skillfully superintended the work until its completion.

THE DIFFERENCE.

In the London Monthly circular of Mr. William Abbott, the following language occurs in reference to the cable communication by the Anglo-American Company: "The splendid organization of the Anglo-American Company has brought the service to as near perfection as it is possible for skill or science to accomplish. The average number of messages per day is 1,150, and is daily increasing. These messages are carried to New York from London *in the short space of* 8½ *minutes*. This is the average speed which may be calculated upon, but in many cases this distance of 3,543 miles is accomplished *in three minutes*. Such a splendid service could only be possible with four cables and a highly trained staff of operators." That is a handsome acknowledgement of a very meritorious service, and stands in marked contrast with another statement, which will be found in our last issue, to the effect that the time of transmission from Madrid to England, *via* Santander, averages *three hours and twenty-six minutes!*

On a circular before us a well-known telegraph official says, in reference to the attempt which was made to establish the Gold and Stock Telegraph system in Europe: "A telegraphic system which could give promptly the market quotations of the principal European cities would undoubtedly succeed but the *present slow transmission* of despatches destroys their commercial value." Now, all we have to say in reference to such statements is, "Why is this thus? Why are private enterprises prompt and others otherwise?"

EXPRESS MESSAGES.

When a few weeks ago we wrote on the subject of what are termed express messages, by which is meant a class of telegrams which, for a consideration in money, are given priority in transmission, we supposed we uttered the universally accepted sentiment of America on this subject, when we pronounced it dangerous and impracticable. There is not a proposition which can be proposed, which would sooner kindle the anger and opposition of the people. And yet the opinion expressed before and reiterated with deeper conviction now, has not only been sharply criticised by a well-known writer, whose ready and caustic pen never leaves one in doubt of his meaning, but the proposition has been taken up approvingly by a contemporary, and has even found an appreciative place in the *Scientific American*. Such being the fact, we feel drawn to a brief review of the subject to see if there be any point in the proposal to justify the approval thus unexpectedly bestowed upon it.

First of all, we have opposed to the system of preference proposed, the all but universal status of State law which makes transmission by telegraph *in the order of reception* imperative and fundamental.

It must be clear to the ordinary sense that with such a law in existence, the acceptance of a message for which a pledge of priority in transmission is given in consideration for money paid, would be an act hostile to public law and, presumably, to public justice. There is no argument necessary in such a case. It is a mere question of fact. The law forbids preference, and imposes a penalty therefor. It recognizes every message as of like value. It was passed to prevent the injustice which preference implies.

We are told that it has been always the custom to give certain messages preference on account of their apparent value. We deny the fact; and even admitting it, we deny that such preference was ever given with the knowledge of the parties sending the messages thus illegally delayed. Such knowledge would have led to universal public protest. We say, therefore that even were it an admitted custom, which it is not, any system, which is possible only by such concealment, is, on its face an affront to law, to morals, and to public justice. Men seek the telegraph office because they expect and need speedy transmission, and a telegraph company has no right to pronounce upon the relative value of messages placed in their hands, or to entertain any system which makes a right of selection a part of its operations.

Again we are asked, why cannot there be an express message as well as an express package, and and the same distinction be made in messages as between slow and fast freights? We answer, simply because the mail and the night service already provide for slow messages. In ordinary telegraphing there is everywhere understood promptitude—the practical annihilation of time. In the night service there is a clear understanding that a message left during the night will be delivered promptly in the morning. There is a measure of exactness in this even more expressive than in ordinary service. It gives all night for a message to reach its destination, and conveys a kind of certainty that by an early hour it will be delivered. This is easy of understanding. It is satisfactory, especially when the service, as is usually the case, is distant. But this would be all wanting in a delayed day service, and the absence of obligation to transmit promptly would lead to widespread carelessness and abuse. No idea of prompt delivery being given, the parties acting under the uncertainty, would resort to the express message with its added cost. This Hubbard & Co. understood when they offered to transmit the public business at a low rate with this privilege of priority messages and a high tariff conceded to them. There was the concealed cream. The priority or express rate would have certainly become the general rate. The scheme of a low tariff, which it bore on its face was the proposition of a sublime deception.

Writing on this very subject a year or more ago, we gave the following illustration. It is just as good now as then.

"A lady steps into an office at Newburgh, and telegraphs her husband to meet her at New York. As the clerk receives it from the fair fingers, he remarks: 'No hurry about this, I presume?' 'No hurry!' replies the astonished lady. 'Why, yes, of course; don't you see my husband must meet me at the depot, and he must get it immediately?' 'Oh!' ejaculates the clerk, 'all right, we will give it '*priority*'—fifty cents, ma'am.' 'But,' rejoins the lady, 'I understand the rate to be only 25 cents; why should I pay more?' 'Oh, you know, ma'am, we put your message ahead of all others, you know, ma'am, and charge double, you know. But if you will take your chances and let us send as we can, why, then, it is only 25 cents.' Of course the 50 cents is paid with a frown and a feeling of indignation. And so in the vast majority of cases would it be found that the real tariff had become 50 cents, and the imaginary one 25, until public indignation broke every telegraph window, and shut up every 'priority' shop."

Gentlemen, it won't do!

The tenth edition of Smith's Manual of Telegraphy and illustrated catalogue of telegraph machinery and material, published by L. G. Tillotson & Company of New York, has been received at this office. Beside the usual amount of information for novices, this edition contains an introductory article from the pen of Mr. Jesse H. Bunnell, which conveys to the beginner, in a concise manner, much needful instruction in the rudiments of the art.

TELEGRAPHERS' ANNUAL REUNION.

The seventh annual Fourth of July re-uuion and excursion of the telegraphers in the employ of the Western Union Company, on the lines of the Erie, New York Central and Northern Central railroads, took place this year, on Monday last, at Hammondsport, and at Spring Grove, on Lake Keuka. There were sixty-five persons in all composing the party, including representatives from all the important offices of the company on the line of the Erie and its branches from New York to Dunkirk and Rochester, on the New York Central from Buffalo to Utica, and on the Northern Central from Elmira to Canandaigua. Several ladies accompanied the party, and added much by their presence to the enjoyment and sociability of the affair. The following letter from Mr. A. B. Cornell, Vice-President of the Western Union Company, to Mr. A. S. Parmalee, manager of the Owego (N. Y.), office, is a gratifying evidence of the favor with which the officers of the company regard these gatherings, as well as the active sympathy and the mutual interest existing between the officers and their employés.

New York, June 25th, 1875,

A. S. Parmelee, Esq., Owego—*My Dear Sir:* I have been much interested by the perusal of the circular in reference to the "Seventh Annual Re-Union of the Telegraphers of New York," which you were kind enough to give me at our recent interview. I cannot doubt that these annual gatherings are the source of much pleasure, and of great good to those of the profession who participate in them.

With the view of promoting the interest of the operators in Central New York, in such a meeting for the next year, I venture to tender through you an invitation to the members of your organization to meet me at Ithaca, on the Fourth of July, next year. As you know, Ithaca is located midway between the Central and Erie roads, and is accessible by a direct train from Syracuse, Cayuga, Geneva, Elmira, Waverly, and Owego, and beside being the centre of much attractive scenery, is the seat of the Cornell University, which owes its origin and much of its subsequent development to men who were successful in the early organization of the telegraph as a business enterprise in the United States, and I feel confident that yourself and associates will find much to interest them, and I hope to fully repay them for the visit.

If this invitation proves acceptable, it will afford me great pleasure in promoting a large attendance of your professional brethren from Central New York and Pennsylvania, and I shall hope to induce the attendance of a number of the officers of this company to meet them.

I will thank you to inform me of the action on this subject at your earliest convenience, and remain with great respect. Yours, very truly,

Alonzo B. Cornell.

The letter was received with applause, and the invitation to hold the next annual re-union at Ithaca unanimously accepted.

A TELEGRAPH OFFICE IN THE CLOUDS.

The Western Union Telegraph is completing a tower of fifty feet in height on the crest of the lofty Highlands of Neversink. The operators, who are to have the most powerful glasses, will be able to distinguish steamers and other vessels twenty miles out.

TELEGRAPH SECURITIES.

Mr. William Abbott, of London, in his Monthly Circular, has the following with respect to telegraph securities: The principal feature of this market during the past month has been the further decline of as much as 10 per cent. in Anglo-American stock which, when added to that recorded in the previous month, makes a reduction of about a million sterling since the meeting in April. It will be remembered that on that occasion I warned the directors that the policy of secresy to which they seemed fatuitously wedded would bring about the very serious results which have thus been experienced. However, they have now practically condemned their own policy by deciding to abandon it, and although the decision comes too late to be of any service to to those who have been frightened out of their stock by the mysterious and alarming statements as regards the traffic, which have been so industriously circulated by the enemies of the company, it is very satisfactory that wiser counsels have at last prevailed, and an end is to be put to the absurd and unsuccessful policy of mystification. Had it not been for the severity of the crisis, the directors would no doubt have still obstinately clung to their practice of not letting the proprietors know the true position of their property; but, like every other concession which the shareholders have desired, it has been wrung from the Board by a force which could not be withstood. Holders of Anglo-stock are sorely puzzled as regards the prospect of their property. Without venturing to predict the future course of events, or to give advice which may not prove valuable, I would say that the most sensible thing to do is to await quietly the threatened competition. So far there has been nothing but alarming rumor as to what this new wonder is to accomplish, but there is this great fact, which the majority of the Anglo-American shareholders do not know, that with the splendid organization of the Anglo-Company the service has been brought as near perfection as it is possible for skill or science to accomplish; thus, the average number of messages over the lines is now 1,150 per day, and is daily increasing. These messages are carried between London to New York in the short space of 8½ minutes. This is the average speed, which may be calculated upon by the customers of the Anglo, but in many cases this distance of 3,543 miles is accomplished in three minutes. Such a splendid service could only be possible with four cables and a highly trained staff of operators. The pending arrangements for extending the line of the Eastern Extension Company from Australia to New Zealand is a most important operation as affecting the interests of that as well as the Eastern Telegraph Company. The rapid development of the colony of New Zealand renders it indispensable that telegraph communication with the mother country should be established without delay, and it is very satisfactory that the colonial authorities have given substantial evidence of their appreciation of its advantages by making a special agreement to enable the tariff to be moderated without detriment to the shareholders. On the completion of this link, there is little doubt that the cable from the Cape *via* Mauritius to Aden will be immediately undertaken. This will be a work of some magnitude, and one in which it is understood the co-operation of the Cape Government will be given in the form of a guarantee. All these new lines will, of course, become valuable feeders to the Eastern Company. The prospectus of the new issue of the Globe Telegraph and Trust Company will be circulated to all telegraph shareholders next week, and I strongly urge upon every proprietor the importance of accepting the valuable additional strength to their investments to be obtained by the preferred and deferred principle of the Globe Trust. Telegraph Construction and Maintenance Company shares have fluctuated during the month, but the low quotations were of short duration, buyers having again come forward to take advantage of them, and prices now show considerable firmness. The advice which I gave so many of my friends to exchange Chatham and Dover stock at £27 into Construction at £24, has already, I am glad to say, resulted beneficially to those who adopted it. I still continue the advice, for in the one case there is the security of sound management, which is wanting in the other, as evidenced by the recent collapse of the most important and necessary fusion ever announced to a body of shareholders. It is extremely probable that at the meeting to be held next month, the Chairman will be in a position to announce some important contracts, including that for the line to unite New Zealand with Australia.

FOREIGN ITEMS.

The International Telegraph Conference at St, Petersburg has passed a resolution forbidding the artificial formation of compound words. The Conference has accepted the principle of letters as a substitute for a measure of words deciding, that, within the limits of Europe, five letters shall be equivalent to a word and on transatlantic lines, or lines going beyond Europe, ten.

The traffic receipts of the Eastern Telegraph Company for the month of May amounted to £30,602, against £30,225 at the corresponding period of 1874; and of the Eastern Extension, Australasian and China Telegraph Company to £17,773, against £18,-879 last year.

The traffic receipts of the Brazilian Submarine Telegraph Company for the month of May amounted to £12,080.

The number of messages passing over the Cuba Sub-marine Telegraph Company's lines during the month of May (including those of the new station at Cienfuegos) was 2,481, estimated to produce £2,400 against 1,788 messages, producing £1,851, in the corresponding month of last year. The actual receipts of the three months ending March amount to £7,153, as compared with the estimated amount of £7,100

The West India and Panama telegraph cable between St. Thomas and St. Kitts has been repaired, and all the stations on the company's system are now, therefore, in telegraphic communication with Europe.

The traffic receipts of the Direct Spanish Telegraph Company for the month of May amounted to £1,442 9*s.* 2*d.*, against £1,494 14*s.* 6*d.*, in April.

The number of messages forwarded from postal telegraph stations in the United Kingdom, for the week ended May 29, was 409,008, an increase over the corresponding week last year of 62,373.

The total number of messages forwarded from postal telegraph stations in the United Kingdom during the week ended the 5th of June, 1875, was 415,-296; week ended June 6, 1874, 385,279; increase in the week of 1875 on that of 1874, 30,017.

The total number of messages forwarded from postal telegraph stations in the United Kingdom during the week ending June 12th, 1875,415,422; an increase on the corresponding week last year of 40,248.

The Anglo-American Telegraph Company announces a quarterly dividend at 1¼ per cent., or at the rate of 5 per cent. per annum.

WESTERN UNION TELEGRAPH CO.,
TREASURER'S OFFICE,
NEW YORK, JUNE 9th, 1875.

DIVIDEND No. 88,

THE BOARD OF DIRECTORS have declared a Quarterly Dividend of **TWO PER CENT.** on the Capital Stock of this Company, from the net earnings of the three months ending June 30th instant, payable at the office of the Treasurer, on and after the 15th day of July next, to shareholders of record on the 19th day of June.

The transfer books will be closed at three o'clock on the afternoon of the 19th instant, and opened on the morning of the 16th of July.

R. H. ROCHESTER,
Treasurer.

WESTERN UNION TELEGRAPH CO.,
TREASURER'S OFFICE,
NEW YORK, July 2d, 1875.

This Company is now prepared to pay the principal and accrued interest of its Bonds, maturing November 1st, 1875, upon delivery of the Bonds at this office.

R. H. ROCHESTER, Treas.

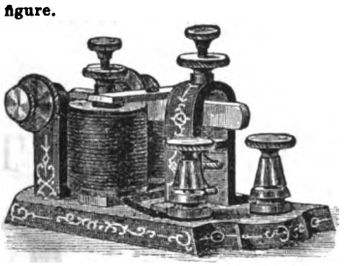
OPERATORS' CHANCE!

ELECTROTYPE Cards of Key, Sounder and Relay, with your name printed in handsome type on 25 extra fine Bristol, white and tinted, for 25c., or 50, with business and address, for 50c. Samples, 3c. Railroad Operators send 10cents extra for conductor's and brakesmans' electrotype cards. You can make money. Agents outfits, with the handsomest and most stylish cards printed, for 25c.

Address, F. P. MUNN,
Clyde, Wayne County, N. Y.

A Great Reduction in Prices.

I am now making a specialty of my PHIL. SHERIDAN SOUNDER AND KEY, and am manufact ring them in large quantities, so that I am able to offer them to the public at a very low figure.



PHIL. SHERIDAN, $4.00.

The above cut represents a beautiful little Sounder. It is made of the best material and highly finished. It has a heavy lever, full sized magnets, and altogether is a first-class instrument. The magnets are wound with green silk insulated wire.

Polished Rubber Covers, 50c. Extra.

PHIL. SHERIDAN KEY, PRICE, $2.00.

You can see at once that the above cut represents a first-class Key in every respect. It is highly finished, has large platinum points, strong lever, friction circuit-closer, spring adjustments, etc., etc. As a Learner's set they have no equal, as they are regular Telegraph Instruments, same as are used on all railroad and commercial lines.

One Cell Callaud Battery, 1 lb. Blue Vitrol, Connection Wire, Book of Instruction, etc., all for $1.50. Making a Complete Outfit for office, only $7.50.

These Instruments will be made to work on from a few feet to 5 miles of line, at the same price. Parties ordering please give length of line that instruments are to be used on. Every set warranted to be just as represented and to give entire satisfaction.

All kinds of Telegraph Instruments and Supplies constantly on hand at the lowest price.

Goods will be sent C. O. D., or on receipt of price. Send stamp for Price List and Catalogue.

A. B. LYMAN,
91½ SENECA ST., Cleveland, Ohio.

CALLAUD BATTERY,

KEPT ON HAND
AND
Orders filled by
W. MITCHELL McALLISTER,
728 Chestnut Street, Philadelphia.
CHARLES WILLIAMS, Jr.,
109 COURT ST., Boston, Mass.
AND BY
The Western Electric Manuf. Co.
Agents for the United States.
220 KINZIE ST., Chicago, Ill.

LECLANCHE BATTERIES.

IMPORTANT NOTICE.

After January 1st, 1875, we allow **20 cents** for each used up Porous Cell of this Battery that is returned to us free of charge in good order. A change is made in the discount to the trade.

A list will be furnished on application to

The LECLANCHE Battery Co.,
40 West 18th Street.

Or to L. G. TILLOTSON & CO.,
Sole Agents,
No. 8 Dey Street.

PHILADELPHIA: 54 South Fourth Street.
CINCINNATI: 22 West Fourth Street.

The "Snapper" Sounder.

PATENTED MARCH 2, 1875.

Polished, 30c., or 6 for $1.50.

Polished nickel-plated base, 50c,, or 6 for $2.

Polished, with knob and screw fastenings, 75c.

PRICE  75 CENTS.

Sent post-paid on receipt of price.

R. W. POPE, Box 5278, N. Y.

EUGENE F. PHILLIPS,

MANUFACTURER OF

REED & PHILLIPS' PATENT INSULLATED TELEGRAPH WIRE,

PATENT RUBBER-COVERED WIRE,

PATENT ELECTRIC-CORDAGE, CABLES, etc., etc.

No. 20 CONDUIT STREET,
PROVIDENCE, R. I.

SENT ON RECEPT OF PRICE.

26 & 28 Waring Block, Cleveland, O.

AMERICAN LINE.

Weekly Mail Steamship service between
PHILADELPHIA AND LIVERPOOL,
CALLING AT QUEENSTOWN,

Sailing every Thursday from Philadelphia, and
Sailing every Wednesday from Liverpool.
The following Steamers are appointed to sail from Philadelphia.

OHIO	July 15	PENNSYLVANIA	Aug. 5
ILLINOIS	July 22	INDIANA	Aug. 12
*KENILWORTH	July 29	*ABBOTSFORD	Aug. 19

PRICES OF PASSAGE IN CURRENCY.

Cabin, $100.

Steerage and intermediate tickets to and from all points at the lowest rates.
Steamers marked with a STAR do not carry intermediate.
Passenger accommodations for all classes unsurpassed.
For passage, rates of freight and other information apply to
GEO. W. COLTON, Agent, 42 Broad street, N. Y.
JOHN McDONALD, Passenger Agent, 8 Battery Place, N. Y.
PETER WRIGHT & SONS, General Agents, 307 Walnut Street, Philadelphia,
Richardson, Spence & Co. Liverpool. | N. & J. Cummings & Bro., Queenstown.

Red Star Line.

Appointed to carry the Belgian and United States Mail.
The following Steamers are appointed to sail
FOR ANTWERP.

From Philadelphia.		From New York.	
NEDERLAND	July 31	SWITZERLAND	July 20
VADERLAND	Aug. 25	STATE OF NEVADA	Aug. 13

FROM ANTWERP.

For Philadelphia.		For New York.	
VADERLAND	Aug. 1	STATE OF NEVADA	July 20
NEDERLAND	Aug. 25	SWITZERLAND	Aug. 13

PRICES OF PASSAGE IN CURRENCY.
First Cabin, - - - $90. Second Cabin, - - $60
Steerage tickets to and from all points at the lowest rates.
Passenger accommodations for all classes unsurpassed.
For passage, rates of freight and other information apply to
GEO. W. COLTON, Agent, 42 Broad Street, N. Y.
JOHN McDONALD, Passenger Agent, 8 Battery Place, N. Y.
PETER WRIGHT & SONS, General Agents, 307 Walnut Street, Philadelphia.
B. vonder Becke, General European Agent, Antwerp.

WESTERN ELECTRIC MANUF'G CO.

SOLE AGENTS,

Orton's Patent Awl Clip.

These Clips have been in practical use for three years, and are rapidly displacing all others,

They are designed for holding messages and every form of blanks.

For convenience, durability and economy they are unsurpassed.

Western Electric Manuf'g Co.

220 KINZIE STREET, Chicago, Ill.

ORTON'S

Patent Security Message Hook.

The damage resulting from the loss of a single message is frequently sufficient to equip a line many times with this hook. Papers cannot be blown or carelessly crowded from it.

These Hooks were first introduced by Geo. H. Bliss & Co.

Thousands of them are in use in telegraph offices, banks and counting rooms.

PRICE 30 CENTS EACH, or $3.00 PER DOZEN.

Liberal terms to the trade.

WESTERN ELECTRIC MFG. CO.,

220 KINZIE STREET, Chicago, Ill.

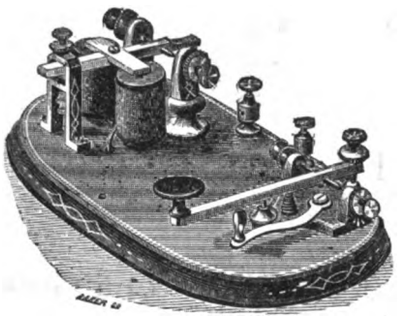
Western Electric Mfg. Co.,

220 KINZIE STREET, Chicago, Ill.

Celebrated

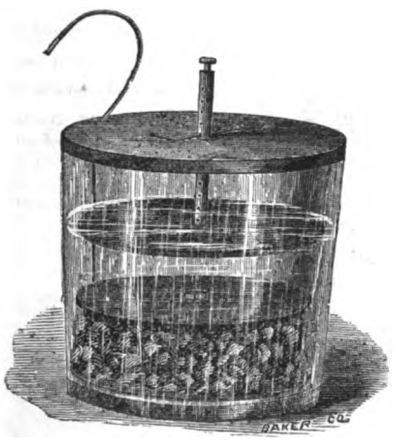
PRIVATE LINE OUTFIT,

THE BEST IN THE MARKET.



PRIVATE LINE INSTRUMENT.

This instrument is mounted on an iron base and finely finished. It gives a clear, loud sound. It is made to work on a line from a few feet to ten miles in length.



BLISS'

RESERVOIR BATTERY.

This Battery took the First Premium and Silver Medal for force, economy and constancy at the Cincinnati Exposition.

With each "Private Line Outfit" is furnished one Private Line Instrument, one cup of Bliss' Reservoir Battery, the necessary Chemicals, Wire for connections, and a Manual.

PRICES:

PRIVATE LINE OUTFIT, complete,	$10 00
INSTRUMENT ONLY,	8 00
BLISS' RESERVOIR BATTERY, per cell,	2 00

DISCOUNTS:

A discount of twenty per cent. will be allowed when remittance is made in advance. Remit by express, registered letter, postal order, or draft.

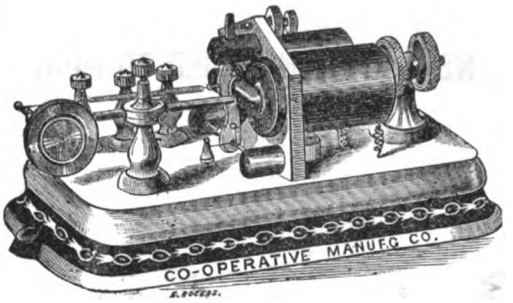
In ordering, state length of line so that the resistance of instruments may be proportioned accordingly.

Send for Circular. Liberal terms to Agents,

WESTERN ELECTRIC MFG. CO.,

Chicago, Ill.

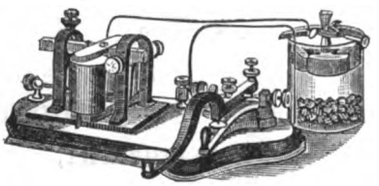
CO-OPERATIVE MFG. CO., 218 Pear St., Philadelphia.



W. U. Pattern Relay.

This Relay is acknowledged to be the best in use. Is finely finished.

Price, - - - - - - $16.

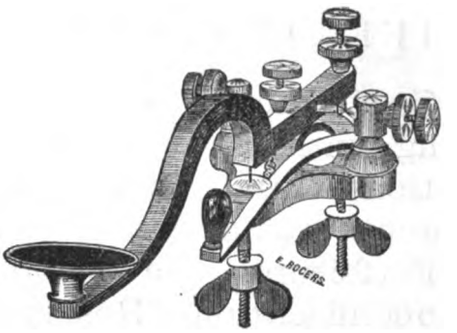


Co-operators' Learners' Instrument No. 1.

A complete outfit embracing a full-size combined Sounder and Key, mounted on a walnut base, with Battery, Chemicals, Wire and all necessary instructions for setting up and operating them, for practising or communicating purposes, being in all respects a regular Morse instrument, comprised of a first-class Sounder and our improved curved lever Key, made in the best manner and nothing ommitted in their construction which could in any way contribute to their efficiency as complete Sounder and Key combined.

The above instrument is nicely finished in brass, and not like other manufacturers' that are made of cast iron.

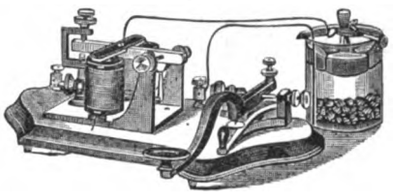
Price of No. 1 Instrument when money is sent in advance,	$8 00
With Battery,	9 50
When sent C. O. D.,	8 50
With Battery,	10 00



No. 1 Key.

This Key is of a beautiful design, and durable in construction, and is perfect in all things which constitue an excellent working Morse Key. No. 1 Key Curved or Straight Lever,

Price, - - - - $4 75
W. U. Pattern Key, - - 5 00



Co-operators' Learners' Instrument No. 2.

THIS BEATS THEM ALL.

We here present a cut of our No. 2 Learners' Instrument, which is comprised of a full size Key and Sounder. We can safely say this Instrument is far ahead of other manufacturers' as to price and quality; it is finished in bronze and mounted on a walnut base.

Price of No. 2 Instrument when money is sent in advance,	$5 00
With Battery,	6 50
When sent C. O. D.,	5 50
With Battery,	7 00

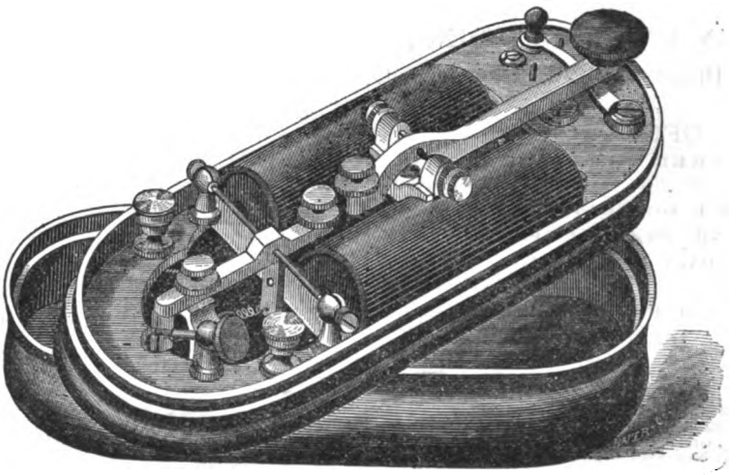
N. B.—Either of the above Instruments can be made to work on a circuit from one to twelve miles by Winding Magnets with fine wire which will make cost of Instrument one dollar extra.

Send for Price List.

W. R. BALDWIN, Manager, 218 Pear Street, Philadelphia.

WESTERN ELECTRIC MANF. CO.

220 Kinzie Street, Chicago, Ill.



POCKET RELAY,

PATENTED JULY 13th, 1875.

Our Patent Pocket Relay has an improved key, large enough to be durable and for practical work.

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THE PHENOMENA OF CHARGE AND DISCHARGE IN TELEGRAPHIC LINES.

If we connect one end of a telegraph line with one pole of a battery and place the other pole of the battery and the other end of the line in connection with the earth, the current pervades the entire line almost instantaneously, reaching the farther end of the line at nearly the same moment that contact is made with the battery. Upon the first appearance of the current at the extreme end of the line, however, it is exceedingly weak, but it constantly increases in strength until it reaches a maximum, which it maintains without further change so long as the connection with the battery continues, and the line is perfectly insulated. If we insert a galvanometer at the distant end of the line, the latter shows no deflection until the current becomes sufficiently strong to influence the needle. The more sensitive the galvanometer is, the sooner it will be affected by the current and the shorter also will be the time that will elapse between the making of the contact with the battery and the perceptible appearance of the current at the distant end. The deflection of the needle continually increases as the strength of current augments, but does not become constant until the current has attained its maximum, which requires a perceptible though very brief interval of time. If we insert several galvanometers at different points upon a long line, and make contact with the battery, the needle of the galvanometer which is nearest the battery will first be deflected, a moment later the second follows, then the third, and finally the one most distant from the battery. In the case of all the galvanometers that are on the half of the line nearest the battery, the angle of deflection increases very rapidly, passing beyond the point at which the needle finally settles, and then again decreases towards that point. It is quite otherwise with the galvanometers that are placed on the second half of the line; their movements, which are feeble at first, continually increase until after a certain time has elapsed, when the galvanometers at the various points all show the same deflection, which continues permanently if the insulation of the line remains constant.

The condition of the line during the time that the strength of current is constantly increasing, that is, from the moment that the line is connected with the battery until the strength of current in all parts of the line is the same, is called the variable state, to distinguish it from the permanent state in which no change of this kind occurs. The permanent state occurs first in the middle of the line, and is attained there four times sooner than at either end.

The time which it takes the current to make itself manifest upon the galvanometer depends upon the sensitiveness of the latter, consequently, neither the instant when the first portion of the current reaches the end of the line, nor the moment when the current begins to be constant, can be exactly determined. Of two galvanometers, the one which is most sensitive is first to show the passage of a current. In consequence of this the duration of the variable condition cannot be stated with absolute exactness, and we are obliged to confine ourselves to the determination of the time which is required for the current to reach a state that approximates closely to the permanent state.

Duration of the Variable State.

If we assume with Ohm that electricity flows through a wire in accordance with the same laws that govern the diffusion of heat in a rod which is heated at one end, we are led to the conclusion that the duration of the variable state is in proportion to the square of the length of the line. If for instance a certain line is 2, 3, 4, or more times as long as another, then the duration of the variable state is 4, 9, 16, etc. times as long as it is for the shorter line.

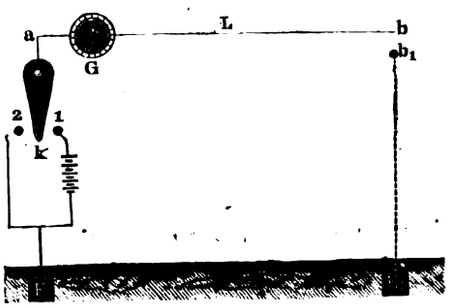

Figure 1.

Gaugain and Guillemin have experimentally proved the accuracy of this law. The duration of the variable state depends also upon the conductivity, the sectional area and the degree of insulation of the line, and upon the quantity of electricity which is required to produce a certain potential through the unit length of line. With ordinary iron telegraph wire of No. 8 gauge the duration for a length of 300 miles, varies according to atmospheric conditions, between .014 and .022 seconds; on an average it may be said of about .018 seconds. In accordance with the preceding law the time t of the variable period for a line of 500 miles would then be given by the proportion

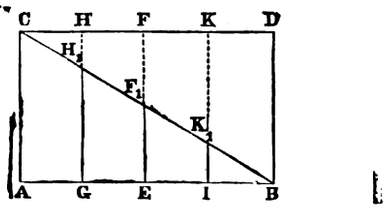

Figure 2.

$$t_1 : .018 = 1 : (300)^2$$

or $$t_1 = .000000162 \text{ second.}$$

We shall hereafter see what influence the other circumstances above mentioned have upon the duration of the variable period.

Charge of an Insulated Land Line.

Ohm's laws give no sufficient explanation concerning the manner in which electricity diffuses itself under some conditions. Many phenomena appear upon long telegraph lines which we do not notice upon short ones, and which are entirely distinct from the phenomena of the ordinary galvanic current.

Wheatstone, Guillemin, and especially Gaugain, have very carefully studied the manner in which electricity from a battery is propagated through a long conductor, and we shall therefore state briefly some of the more important results of these examinations.

If, by turning the switch k on 1 (fig. 1) a wire completely insulated throughout is put in connection with one pole of a battery, the other pole being to earth at E, we shall find that the galvanometer G interposed between the wire and the battery indicates a current the moment that the switch is turned on 1. This current, which is powerful in proportion to the length of the line, originates therefore without the existence of a closed circuit, but its full strength lasts only for a very small portion of a second. After the first and almost instantaneous deflection, the needle of the galvanometer again returns to its state of rest, or at most only shows a very small deflection in consequence of the line L not being perfectly insulated.

As soon as the line wire L is connected to the pole of the battery, it becomes electrified, and attains throughout its entire length the same potential as the pole of the battery itself possesses; consequently, as the current passes into the wire it manifests it presence first in the neighborhood of the battery. This effect, however, ceases as soon as the charge reaches the extreme end b of the line, and the line itself attains at all points the same potential as the battery pole. The earth E with which the other pole of the battery is connected, may be replaced by any other conductor having the same resistance as the line L.

Although the electrical potential of the battery poles and of the separate parts of the line may not be very high, yet the amount of electricity which flows into the wire may be considerable, as a long line has, in the aggregate, a very large surface; consequently, a considerable amount of electricity, when distributed over the entire surface, would present at any given point of it only an inconsiderable density, and consequently a low potential. A No. 8 wire, such as is ordinarily used for telegraph lines, has a surface of 228.04 square feet per mile, and a No. 6 wire 280.37 square feet per mile, which would give for a line of 500 miles the enormous surface 140,185 square feet.

When the wire L has attained an equal potential at all points, in consequence of having been connected with the pole of the battery, the wire is said to be statically charged, and the operation is termed charging the wire.

The charge extends only over the surface of the line wire, and its amount is determined both by the magnitude and form of this surface. It is proportional to the length of the line when the latter is so